Vol. 16. Part 2.

Rubber Research Scheme (Ceylon)

Second Quarterly Circular for 1939.

June, 1939.

Rubber Research Scheme (Ceylon)

BOARD OF MANAGEMENT.

Chairman:

The Acting Director of Agriculture, Mr. E. Rodrigo, C.C.S.

Treasury Representative:

The Deputy Financial Secretary, Mr. C. H. Collins, C.C.S.

Unofficial Members of the State Council nominated by the Governor:

Mr. George E. de Silva, M.S.C.

Mr. E. C. Villiers, M.S.C.

Mr. R. C. Kannangara, M.S.C.

Members nominated by the Ceylon Estates Proprietary Association:

Mr. J. C. Kelly

Mr. A. W. Harrison (acting).

Members nominated by the Planters' Association of Ceylon:

Mr. L. E. Russell (acting).

Mr. B. M. Selwyn.

Members nominated by the Rubber Growers' Association:

Mr. I. L. Cameron.

Mr. E. W. Whitelaw.

Members nominated by the Low-Country Products Association:

Mr. Leo B. de Mel, J.P., U.P.M.

Mr. T. Amarasuriya.

Mr. N. D. S. Silva.

Mr. T. C. A. de Soysa.

Members nominated by the Governor to represent Smallholders:

Mr. F. A. Obeyesekere.

Mr. W. P. H. Dias, J.P.

Experimental Committee:

Mr. W. P. H. Dias, J.P.

Mr. F. A. Obeyesekere

Mr. L. E. Russell (acting)

Mr. B. M. Selwyn.

Mr. T. E. H. O'Brien (Convener)

STAFF.

Director.—T. E. H. O'Brien, M.Sc., F.I.C., F.I.R.I.

Botanist & Mycologist.—R. K. S. Murray, A.R.C.Sc.

Geneticist.—Dr. C. E. Ford, Ph.D. (Lond.), B.Sc. (Lond.)

Assistant Botanist.—C. A. de Silva, B.Sc., Agric. (Lond.), C.D.A. (Wye).

Soil Chemist.—Dr. L. A. Whelan, M.Sc. (N.Z.), Ph.D. (Aberd.), A.I.C.

Chemist.—M. W. Philpott, M.Sc., A.I.R.I.

Smallholdings Propaganda Officer.—W. I. Pieris, B.A. Hortic. (Cantab).

Estate Superintendent.—D. L. Nicol.

Secretary to the Director.—C. D. de Fonseka.

Office and Laboratories.—Dartonfield Estate, Agalawatta, Ceylon.

CONTENTS

ORIGINAL ARTICLES

Page

Field Experiments on Dartonfield Estate—IX.

Comparison of Tapping Systems. By R. K. S. Murray and C. A. de Silva 47

The Performance of Imported Clones in Ceylon—III. By C. E. Ford 65

Oidium Leaf Disease in Ceylon in 1939. By R. K. S. Murray 81

Identification of Clones on Ceylon Estates. By R. K. S. Murray 89

SELECTED ARTICLE

Synthetic Substitutes for Rubber 93

MEETINGS, ETC.

Minutes of the Forty-seventh Meeting of the Rubber Research Board 95

NOTICES.

DARTONFIELD ESTATE—VISITORS' DAYS

The *second* and *fourth* Wednesdays in each month have been set aside as Visitors' Days at Dartonfield estate, and the services of technical officers will be available to visitors on those days. The estate superintendent will be available every Wednesday. Visitors are requested to arrive on the estate not later than 9.30 a.m.

While visitors will be welcomed at the Station on other days, any particular member of the staff may not be free to give them attention unless an appointment has been made.

Dartonfield estate is situated about $3\frac{1}{2}$ miles from the main Matugama-Agalawatta Road, the turn-off being near culvert No. 14/10. The distance from Colombo is approximately 47 miles.

PUBLICATIONS

Rubber Research Scheme publications comprising Annual Reports, Quarterly Circulars and occasional Bulletins and Leaflets are available without charge to the Proprietors (resident in Ceylon), Superintendents and Local Agents of Rubber estates in Ceylon) over 10 acres in extent. Application for registration should be made to the Director, stating the name, acreage, and registered number of the estate(s) concerned.

IDENTIFICATION OF CLONES

The attention of Proprietors and Superintendents undertaking replanting or budgrafting programmes is drawn to Planting Manual No. 5 : "The History and Description of Clones of *Hevea Braziliensis*," issued by the Rubber Research Institute of Malaya, copies of which may be purchased on application to these Laboratories for Rs. 5.00 each (postage free). This publication gives drawings and descriptive particulars of the more important clones, which should enable Superintendents to verify the authenticity of their material.

FIELD EXPERIMENTS ON DARTONFIELD ESTATE—IX

COMPARISON OF TAPPING SYSTEMS

R. K. S. MURRAY, *Botanist & Mycologist*
and
C. A. de Silva, *Assistant Botanist*

THIS paper describes an experiment to compare the relative merits of a number of tapping systems, and summarises the results for the first two years.

Experimental Details

Site.—The experiment is carried out in Nos. 3 and 6 fields on Dartonfield, three replications being in one field and three in the other. The years of planting, average stand per acre and approximate estate yields on the Double-Four system of tapping for the two years prior to the commencement of the experiment are as under :

Field No.	Year Planted	Stand per Acre	Yield per Acre per Annum
3	1917	94	570 lb.
6	1913	95	620 „

It will be observed that the yielding capacity of the trees is above average and this fact must be borne in mind when interpreting the results.

The experimental areas were manured in March, 1937, with 300 lb. per acre of sulphate of ammonia and 100 lb. of rock phosphate. The only previous record of cultivation is an application of a complete mixture about ten years previously.

Treatments.—The methods of tapping under comparison are as follows :—

Two-day series

1. Half spiral on alternate days, with change of panel every six months. Bark consumption $5\frac{1}{2}$ in. per annum. (Int. 70).
2. Ditto with A.B.C. 12/6 cycle of periodic rest. Bark consumption $\frac{3}{4}$ in. per annum. (Int. 47).
3. Half spiral on alternate days but on alternating sides, *i.e.*, the tree is tapped on alternate days, but each cut once in four days. Bark consumption 7 in. per annum. (Int. 70).
4. Two quarter spirals in echelon on alternate days, the bottom of the left cut being 6 in. below the top of the right. Change of panel every six months. Bark consumption $5\frac{1}{2}$ in. per annum. (Int. 70).
5. Double-Four, *i.e.*, two opposite half spiral cuts once in four days. Bark consumption 7 in. per annum. (Int. 70).
6. Ditto with A.B.C. 12/6 cycle of periodic rest. Bark consumption $4\frac{3}{4}$ in. per annum. (Int.47).

Three-day series

7. Half spiral once in three days, with change of panel every six months. Bark consumption $4\frac{1}{2}$ in. per annum. (Int. 47).
8. Double-Three, *i.e.*, two opposite half spiral cuts once in three days. Bark consumption 9 in. per annum. (Int. 93).
9. Ditto with A.B. 6/6 cycle of periodic rest. This is sometimes known as the Sunderland system. Bark consumption $4\frac{1}{2}$ in. per annum. (Int. 47).
10. Ditto with A.B.C. 12/6 cycle of period rest. Bark consumption 6 in. per annum. (Int. 62).
11. Ditto with A.B.C. 8/4 cycle of periodic rest. Bark consumption 6 in. per annum. (Int. 62).

The figure in brackets denotes the intensity of the tapping system, and is the equivalent number of annual tappings on a full circumference, assuming 280 tapping days a year.

For convenience of tapping arrangements, as explained below, the treatments are divided into two series : those with a two or

four-day interval between tappings (two-day series) and those with a three-day interval (three-day series).

The usual Ceylon custom of resting for three or four weeks during the annual period of refoliation is followed, so the tapping year actually consists of about 11 months. In the periodic systems the periods of tapping and rest are adjusted accordingly so that, for example, A.B.C. 12/6 should really read A.B.C. 11/5½.

The stated rates of bark consumption are those considered from general estate experience to be rational for the several systems of tapping. They are based on the following monthly rates :—

Two-day interval	...	...	... ·50 in. per month
Three-day interval	...	...	... ·40 „ „
Four-day interval	...	...	... ·32 „ „

The figures given do not include the extra shavings which have to be removed when re-opening cuts which have been rested for some months. Where a period of rest is an integral part of the system the figure for annual consumption is the average for all trees.

Lay-out.—The unit plot consists of 30 trees. The randomised block arrangement has been adopted, replication being six-fold, but to avoid tapping complications it was necessary to dispose the six plots comprising the two-day series together in one sub-block and the five plots of the three-day series in another. The two sub-blocks are separately randomised in pairs in each block. In all, 1,980 trees are involved in the experiment.

Tapping Arrangements.—Five tappers are employed, three on the two-day series and two on the three-day series. Each taps a sub-block daily, thus eliminating the factor of varying skill as *within* the sub-blocks. To equalise matters *between* the sub-blocks the tappers are rotated every two months.

Where some treatments involve tapping on one cut and others on two cuts it is not altogether easy to arrange the tasks so that each tapper has an equivalent amount of work. This, however, has been done as far as possible on the basis that a man can tap five-eighths as many trees on two cuts as he can on one cut.

Where the treatment involves a rotational period of rest the plot is divided into three (or two) sub-plots.

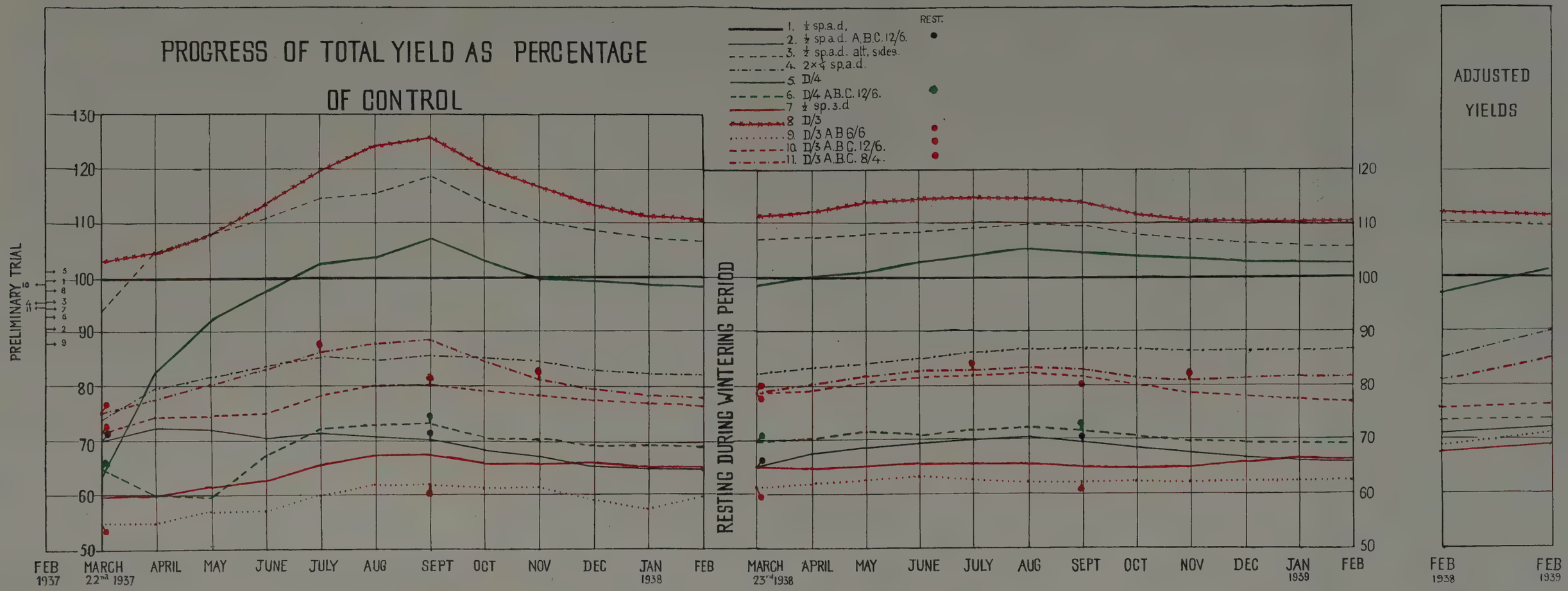
Collecting and Yield Recording.—Each tapper collects his own latex into the requisite number of receptacles, each of which is painted with the colour, or combination of colours, representing the particular treatment. On arrival at the factory the latex from each plot is strained, weighed and recorded. A determination of rubber content is made by trial coagulation, and thus the yield of dry rubber calculated. Scrap is separately collected, dried and weighed.

Height of Tapping Cuts.—When commencing an experiment of this nature on mature trees it is necessary to continue tapping the panels at the existing levels. In the experimental areas in question there is no regularity in the heights of the cuts, but the figures given in brackets in Table I show that the means for the various treatments even out satisfactorily for both 1936/37 and 1937/38. It may be concluded, therefore, that differences due to height of cut do not constitute a disturbing factor in the results presented.

When the cut reaches the base of the tree it should, ideally, be re-opened at a height depending on the rate of bark consumption for the particular system concerned, so that the cycle remains the same for all treatments. For example, if on System No. 1, with an annual bark consumption of $5\frac{1}{2}$ inches, the panel is re-opened at a height of 27 inches, on System No. 2, with a consumption of $3\frac{3}{4}$ inches, the height should be only $18\frac{1}{2}$ inches. In practice, however, it has been impossible to conform to this principle as, owing to higher rates of consumption in the past, the bark at *e.g.* $18\frac{1}{2}$ inches is not sufficiently mature to tap. The procedure adopted is to re-open at a height of 27 inches except for Systems Nos. 3, 5, 8, 10 and 11, in which the cuts are opened at 30 inches. This means that the milder systems of tapping are not given the full advantage of lower average levels due to the slower consumption, but this would usually be the case where a change from a full to a periodic system is made.

Results

Yield.—The results discussed in this paper refer to the two periods—March, 1937, to February, 1938, and March, 1938, to February, 1939. March-February constitutes the most convenient tapping year since tapping is suspended for three or four weeks in February-March during the refoliation of the trees after the annual "winter."


PROGRESS OF TOTAL YIELD AS PERCENTAGE OF CONTROL
1. ½ sp.a.d.
2. ½ sp.a.d. A.B.C. 12/6.
3. ½ sp.a.d. alt. sides.
4. 2×¼ sp.a.d.
5. D/4
6. D/4 A.B.C. 12/6.
7. ½ sp. s.d
8. D/3
9. D/3 A.B 6/6
10. D/3 A.B.C. 12/6.
11. D/3 A.B.C. 8/4.
REST.
PRELIMINARY TRIAL
RESTING DURING WINTERING PERIOD
ADJUSTED YIELDS
130
120
110
100
90
80
70
60
50
FEB 1937
MARCH 22nd 1937
APRIL
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
JAN 1938
FEB
MARCH 23rd 1938
JAN 1939
FEB 1938
FEB 1939

The period April, 1936, to February, 1937, was used for a uniformity trial, all plots being tapped on a half spiral cut on alternate days. The respective figures for the experimental years 1937/38 and 1938/39 have been adjusted by means of a regression on the results of the uniformity trial according to the method described for the manuring experiment on Dartonfield in *Quarterly Circular*, Vol. 15, Part 1.

A discussion of statistical methods is beyond the scope of this paper, but reference must be made to the fact that the arrangement of the plots in two sub-blocks (two and three-day series respectively) necessitates modification in the analysis of variance and calculation of plot errors. In comparing treatments between sub-blocks the appropriate estimate of error is derived from a combination of the errors between and within sub-blocks. Hence the value for the significant difference between treatments differs slightly according as to whether the comparison is between treatments in the same series or in different series.

The results for the years 1937/38 and 1938/39 are given in Tables I and II respectively. The yields are not expressed in terms of lb. per acre for two reasons : in the first place the determinations are made on a tree and not on an acreage basis, and secondly, partial " wash-outs " are excluded from the records so that a calculation in terms of yield per acre per annum would slightly understate the true yielding capacity. To obtain an estimate of the approximate yield in lb. per acre each figure for kilograms per plot should be multiplied by 7. These tables also give the proportion of scrap expressed as a percentage of the total crop. Since aluminium cups are used and these are brought to the factory to be washed there is no cup-scrap.

Table III gives the yields for the various treatments for each year separately, and the two years together, expressed as percentages of System No. 1.

The progress of the total yield from the various systems as a percentage of System No. 1 is illustrated in the graph, each point representing the cumulative yield up to that time. These yields have not been adjusted by a regression and therefore the positions as at February, 1939, do not quite conform to the figures in the fourth column of Table III. The initial levels as at February, 1937,

are shown to the left of the graph, and a subsidiary graph giving the *adjusted* percentages as at February, 1938, and February, 1939, is reproduced on the right. These levels correspond to the figures in columns 2 and 4 of Table III.

Two years is, of course, an insufficient period of time in which to assess fully the relative merits of different methods of tapping, and the results can only be regarded as of an interim nature. It is interesting to note that in the first year the yields of the less intense systems, viz. Nos. 2, 6, 7 and 9 have not greatly exceeded the theoretical proportion of No. 1, but that they have increased in the second year, indicating the benefit to the trees of the milder tapping. The following comments are submitted on the several tapping systems :—

No. 1. *Half Spiral Alternate Day.*—This may be considered as the control with which the other methods of tapping are compared. The yield was almost the same for the two experimental years and is equivalent to about 575 lb. per acre.

No. 2. *Half Spiral Alternate Day with A.B.C.* 12/6 *Periodic Rest.*—In the first year the yield is not much higher than the theoretical 67 per cent. of the control, but in the second year it has risen to 74 per cent., showing the benefit of the periodic rest.

No. 3. *Half Spiral Alternate Day on Alternating Sides.*—This method, which is of equal intensity to the control, has given a significantly higher yield in the first year, and in the second the difference in its favour is only just below the level of significance. Apart from the slightly higher bark consumption this system does not at present show any disadvantages and seems worthy of trial on estates. The treatment is somewhat similar to the double-four system in that each cut is tapped once in four days, but, except inasmuch as the yield is higher, it does not carry the same advantage of reducing tapping costs.

No. 4. *Two Quarter Cuts in Echelon on Alternate Days.*—No explanation can be given for the relatively low yield of this system in the first year, but in the second it is no longer significantly lower than the control. This system might be expected to show an advantage on large trees when the cut reaches the base, but practical difficulties are sometimes encountered in marking out the left quarter when a new panel is commenced.

No. 5. *Double-Four.*—In neither year is the figure significantly different to that of the control plots, but there seems to be a tendency for the yield to rise. It must be stated that this experiment does not do justice to any of the double-cut systems in one respect: owing to the fact that partial "wash-outs" are ignored these systems do not receive the benefit, which is experienced in commercial practice, of quicker collection of latex in showery weather. There is little indication of the higher proportion of scrap which was found to be a concomitant of double-cut systems in a tapping experiment in Malaya.

No. 6. *Double-Four with A.B.C.* 12/6 *Periodic Rest.*—The yield curve follows close to that of System No. 2 which is of equal intensity.

No. 7. *Half Spiral Once in Three Days.*—For the first year the yield is almost exactly the theoretical 67 per cent. of the control, but it shows a tendency to rise. As is to be expected this system gives the highest value for dry rubber content. It has also given a relatively high proportion of scrap.

No. 8. *Double-Three.*—This system is included, not because it is likely to prove of value for permanent adoption, but because it is of interest as a mild form of drastic tapping prior to replanting. In point of fact the satisfactory manner in which the yield of these plots has been maintained is one of the most interesting and unexpected features of these results. There has, of course, been a drop since the early months, in which the increased yield over the control approximated to the theoretical figure of 33 per cent., but over the period of two years the extra crop is 12 per cent. The dry rubber content of the latex has also been well maintained.

No. 9. *Double-Three with A.B.* 6/6 *Periodic Rest.*—The intensity of this system is two-thirds that of No. 1, and in the first year the relative yield at 69 per cent. almost conforms to the theoretical. As in the other milder systems the trees appear to be deriving benefit from the periodic rest, and in the second year the proportion has risen to 73.6 per cent.

No. 10. *Double-Three with A.B.C.* 12/6 *Periodic Rest.*—The intensity of this system is about 90 per cent. of the control, and it will be observed that the proportionate yield falls far short of this

figure. There has, however, been a rise in the second year. In the first year it is almost exactly the theoretical two-thirds of System No. 8.

No. 11. Double-Three with A.B.C. 8/4 Periodic Rest.—This differs only from No. 10 in that the trees are rested in rotation for four months in 12 instead of 6 months in 18. The shorter cycle has clearly resulted in improved yield, the difference between these two systems in 1938/39 being statistically significant. This result confirms the similar finding in Malaya.

TABLE I

MEAN YIELDS IN KILOGRAMS TOTAL DRY RUBBER PER PLOT OF 30 TREES *

YEAR 1937/38

	Tapping System	Preliminary Year 1936/37**	Experimental Year 1937/38	Adjusted Yields 1937/38	Scrap as per cent. of Total
Sub-Block A Two-Day Series	1. ½ sp.a.d.	66·6 (13·1)	84·8 (17·4)	82·0	9·0
	2. ½ sp.a.d.A.B.C. 12/6	60·9 (11·4)	54·8 (15·0)	58·1	12·0
	3. ½ sp.a.d. alt. sides ...	64·1 (11·8)	90·7 (17·3)	90·5	9·4
	4. 2 × ½ sp.a.d.... ...	63·9 (12·2)	69·7 (19·6)	69·7	11·2
	5. D/4	67·8 (11·9)	83·3 (18·8)	79·4	8·5
	6. D/4 A.B.C. 12/6 ...	62·3 (12·3)	58·3 (16·4)	60·0	7·8
Sub-Block B Three-Day Series	7. ½ sp.3.d.	63·3 (11·5)	55·0 (18·6)	55·6	11·3
	8. D/3	65·5 (13·1)	93·7 (18·5)	92·1	9·3
	9. D/3 A.B. 6/6 ...	59·0 (11·6)	51·5 (18·3)	56·6	11·2
	10. D/3 A.B.C. 12/6 ...	66·4 (11·6)	64·7 (18·9)	62·2	10·5
	11. D/3 A.B.C. 8/4 ...	63·6 (12·5)	66·1 (19·0)	66·4	10·5
	Mean	63·9 (12·1)	70·2 (18·0)	70·2	
	Standard error			2·8	
	Significant diff. (0·5) within sub-blocks			7·8	
	Do. between sub-blocks			8·6	

*Approximate conversion to lb. per acre × 7.

**10 months' tapping only.

Figures in brackets denote mean heights of tapping cuts in inches at the end of the tapping year.

TABLE II

MEAN YIELDS IN KILOGRAMS TOTAL DRY RUBBER PER PLOT OF 30 TREES*

YEAR 1938/39

	Tapping System	Preliminary Year 1936/37**	Experimental Year 1938/39	Adjusted Yields 1938/39	Scrap as per cent. of Total
Sub-Block A Two-Day Series	1. ½ sp.a.d.	66·6	85·6	82·6	9·1
	2. ½ sp.a.d. A.B.C.12/6	60·9	57·6	61·1	11·2
	3. ½ sp.a.d. alt. sides ...	64·1	89·9	89·7	9·5
	4. 2 × ¼ sp.a.d.... ...	63·9	78·0	78·1	10·2
	5. D/4	67·8	91·5	87·3	10·2
	6. D/4 A.B.C. 12/6 ...	62·3	59·6	61·3	8·3
Sub-Block B Three-Day Series	7. ½ sp.3.d.	63·3	58·1	58·8	10·8
	8. D/3	65·5	94·0	92·2	10·3
	9. D/3 A.B. 6/6 ...	59·0	55·3	60·8	10·2
	10. D/3 A.B.C. 12/6 ...	66·4	66·8	64·1	11·2
	11. D/3 A.B.C. 8/4 ...	63·6	73·1	73·5	9·8
	Mean ...	63·9	73·6	73·6	
	Standard error			3·1	
	Significant diff. (·05) within sub-blocks			8·9	
	Do. between sub-blocks			8·7	

*Approximate conversion to lb. per acre ×7

**10 months' tapping only.

TABLE III

ADJUSTED YIELDS AS PERCENTAGE OF SYSTEM No. 1

	Tapping System	1937/38	1938/39	1937/39
Sub-Block A Two-Day Series	1. ½ sp.a.d.	100·0	100·0	100·0
	2. ½ sp.a.d. A.B.C. 12/6 ...	70·8	74·0	72·3
	3. ½ sp.a.d. alt. sides	110·4	108·6	109·5
	4. 2×¼ sp.a.d....	85·0	94·5	89·8
	5. D/4	96·8	105·7	101·2
	6. D/4 A.B.C. 12/6	73·2	74·2	73·6
Sub-Block B Three-Day Series	7. ½ sp.3.d.	67·8	71·2	69·4
	8. D/3	112·3	111·6	111·9
	9. D/3 A.B. 6/6	69·0	73·6	71·3
	10. D/3 A.B.C. 12/6	75·8	77·6	76·7
	11. D/3 A.B.C. 8/4	81·0	89·0	84·9
	Mean	85·6	89·1	87·4
	Standard error	3·4	3·8	3·3
	Significant diff. (·05) within sub-blocks ...	9·5	10·8	9·5
	Significant diff. (·05) between sub-blocks ...	10·5	10·5	9·7

Cost of Tapping.—Actual figures for cost of tapping cannot be kept with a small scale experiment of this nature, but it is possible to calculate theoretical figures from the relative yields, assuming the sizes of tasks with single-cut and double-cut systems to be in the proportion 8 : 5. Such figures are presented in Table IV, based on the yields for the two year period.

TABLE IV

Relative Costs of Tapping

Tapping System	Per Cent.
1. ½ sp.a.d.	100
2. ½ sp.a.d. A.B.C. 12/6	92
3. ½ sp.a.d. alt. sides	91
4. 2×¼ sp.a.d.	112
5. D/4	79
6. D/4 A.B.C. 12/6	73
7. ½ sp.3.d.	96
8. D/3	95
9. D/3 A.B. 6/6...	75
10. D/3 A.B.C. 12/6	93
11. D/3 A.B.C. 8/4	84

Dry Rubber Content.—The mean monthly figures for dry rubber content of the latex are given in Tables V and VI, and the annual means in Table VII.

The main points of interest are the relatively high d.r.c. for third-day tapping (No. 7), which is in accordance with expectations, and the maintenance of a good figure for the double-three system (No. 8), which is not. All systems have given latex with a satisfactory dry rubber content.

TABLE V

MEAN DRY RUBBER CONTENT PER CENT.

Month	TAPPING SYSTEMS										
	1	2	3	4	5	6	7	8	9	10	11
March 1937 ...	37·5	35·1	37·5	37·5	37·9	39·2	34·8	38·8	32·0	38·2	36·4
April ,, ...	41·2	41·4	41·7	40·5	42·4	43·1	43·4	42·1	40·8	41·8	40·5
May ,, ...	39·4	37·1	37·4	38·1	40·4	39·9	42·0	40·4	39·2	38·3	38·3
June ,, ...	40·4	39·3	37·5	39·8	40·7	39·4	41·9	40·2	38·2	39·4	37·4
July ,, ...	39·3	38·6	38·7	39·3	39·2	39·2	41·6	40·9	37·4	39·0	38·0
August ,, ...	39·5	41·3	37·9	40·9	38·8	39·3	42·0	39·1	36·9	38·8	37·7
September ,, ...	41·6	42·1	40·1	42·9	40·0	40·6	41·3	40·1	37·5	39·4	39·1
October ,, ...	44·3	44·8	41·6	42·9	42·6	44·4	44·3	41·5	42·1	42·7	39·2
November ,, ...	42·2	42·3	41·1	42·7	42·2	42·3	44·1	41·3	41·1	41·6	39·8
December ,, ...	40·4	39·4	39·6	41·3	41·0	40·9	42·4	40·6	39·1	39·6	41·3
January 1938 ...	40·5	40·1	39·1	41·4	41·1	40·3	42·3	40·3	39·2	39·9	38·8
February ,, ...	42·8	42·1	41·2	43·5	42·7	42·0	44·4	42·3	41·4	42·2	40·5

N.B.—The figures underlined denote the months in which tapped and rested sections were changed over.

TABLE VI

MEAN DRY RUBBER CONTENT PER CENT.

Month	TAPPING SYSTEMS										
	1	2	3	4	5	6	7	8	9	10	11
March 1938 ...	44·3	46·1	42·6	45·5	43·6	44·8	44·9	42·7	45·6	44·0	43·6
April „ ...	42·9	42·3	40·8	43·9	41·6	42·0	43·8	41·0	41·7	41·5	40·5
May „ ...	40·6	38·7	40·2	42·0	40·7	39·2	42·0	38·5	37·5	39·1	37·8
June „ ...	41·9	39·9	40·3	42·3	41·0	39·8	42·4	40·4	36·7	39·9	38·6
July „ ...	41·8	40·0	40·5	42·4	41·6	38·9	43·2	41·3	38·5	40·4	41·9
August „ ...	40·9	38·9	39·6	40·5	40·1	41·1	43·1	40·8	38·2	40·0	39·7
September „ ...	43·3	44·7	40·2	43·1	41·7	43·9	44·2	41·9	46·6	42·8	40·5
October „ ...	40·4	42·4	39·5	40·8	41·1	40·6	42·0	40·8	40·1	40·8	38·9
November „ ...	41·0	42·2	40·8	42·3	42·2	42·0	43·6	42·0	40·5	41·8	41·8
December „ ...	40·4	41·4	39·7	41·6	42·3	41·7	42·9	41·5	40·2	40·7	39·9
January 1939 ...	40·3	41·2	40·0	41·0	42·0	41·5	42·0	40·8	39·4	39·9	39·0
February „ ...	40·5	42·0	40·3	41·9	43·2	42·1	43·5	42·3	39·8	40·5	39·5

N.B.—The figures underlined denote the months in which tapped and rested sections were changed over.

TABLE VII

DRY RUBBER CONTENT PER CENT.

Tapping System	1937-38	1938-39
1. ½ sp.a.d.	40·8	41·5
2. ½ sp.a.d. A.B.C. 12/6	40·5	41·4
3. ½ sp.a.d. alt. sides	39·5	40·3
4. 2×¼ sp.a.d.	40·8	42·2
5. D/4	40·8	41·6
6. D/4 A.B.C. 12/6...	40·9	41·3
7. ½ sp. 3. d.	42·3	43·0
8. D/3	40·6	41·0
9. D/3 A.B. 6/6	38·9	40·3
10. D/3 A.B.C. 12/6	40·1	40·8
11. D/3 A.B.C. 8/4	39·0	40·0
Mean	40·4	41·2
Error	0·51	0·46
Significant diff. (·05) within sub-blocks ...	1·4	1·3
Do. between sub-blocks ...	1·4	1·4

Bark Renewal.—At the commencement of the experiment a point was marked with tar in a central position above each tapping cut to indicate the level of the bark tapped in February, 1937. Measurements of the thickness of the renewed cortex were made on every tree at this point in March, 1938, and March, 1939.

The instrument used was the Schlieper gauge and the determination made to the nearest ·5 mm. Tests have shown that this instrument gives a reading which is, on an average, about ·5 mm. too high, and the figures have accordingly been corrected by this amount.

The corrected measurements made in 1938 and 1939 are given in Table VIII. It will be seen that in the former year 0·2 mm., and in the latter 0·3 mm., covers the full range of treatment means,

and statistical analysis shows, in fact, that none of the differences is significant. Although under the conditions of the experiment the various methods of tapping have had no appreciable effect on the rate of renewal, it would be unwise to apply this conclusion to trees which are in a less satisfactory general condition, or on which, for any reason, the rate of renewal is much slower.

TABLE VIII

Thickness of Renewing Cortex in Millimetres

Tapping System	March, 1938 (13 months)	March, 1939 (25 months)	Increase 1938/39
1. ½ sp.a.d.	5·8	6·6	0·8
2. ½ sp.a.d. A.B.C. 12/6	5·8	6·9	1·1
3. ½ sp.a.d. alt. sides	5·9	6·8	0·9
4. 2×¼ sp.a.d.	5·9	6·6	0·7
5. D/4	6·0	6·7	0·7
6. D/4 A.B.C. 12/6	5·9	6·9	1·0
7. ½ sp. 3. d.	5·9	6·6	0·7
8. D/3	5·8	6·8	1·0
9. D/3 A.B. 6/6	5·9	6·8	0·9
10. D/3 A.B.C. 12/6...	5·9	6·9	1·0
11. D/3 A.B.C. 8/4	6·0	6·6	0·6
Mean	5·9	6·7	0·8

Differences not significant.

Owing to the variability in the height of the tapping cuts the measurements were made at all levels, and this has afforded an opportunity of determining whether there is any difference between double-cut and single-cut systems in the relative rates of renewal (1) where the renewal has taken place above the cut, and (2) where, owing to the re-opening of the panel at the top, it has taken place below the cut.

TABLE IX

Thickness of Renewing Cortex, February, 1937-March, 1938.

Tapping System	Measurements above cut		Measurements below cut	
	mm.	Per Cent. of No. 1	mm.	Per Cent. of No. 1
1. ½ sp.a.d....	5·7	100·0	5·9	100·0
2. ½ sp.a.d. A.B.C. 12/6	5·8	101·8	5·9	100·0
3. ½ sp.a.d. alt. sides	5·8	101·8	6·0	101·7
4. 2×¼ sp.a.d.	5·7	100·0	6·0	101·7
5. D/4	6·1	107·0	6·0	101·7
6. D/4 A.B.C. 12/6	5·8	101·8	6·0	101·7
7. ½ sp.3.d....	5·7	100·0	6·1	103·4
8. D/3	5·7	100·0	5·7	96·6
9. D/3 A.B. 6/6	5·8	101·8	6·0	101·7
10. D/3 A.B.C. 12/6	5·9	103·5	5·8	98·3
11. D/3 A.B.C. 8/4...	6·1	107·0	5·9	100·0

In a paper giving the results of an experiment in Malaya Sharp* shows that the renewal above the tapping cut is more rapid with double-cut than with single-cut systems, but that below the cut the position is reversed. For example, comparing the double-four with the half spiral alternate day system, the thickness of three-year-old renewed bark is found to be 21·6 per cent. greater above the cut and 16·3 per cent. less below the cut. This is attributed to the additional interference to the downward translocation of food substances imposed by the second cut. In other words, the two cuts cause a partial ringing of the tree, resulting in an accumulation of food and therefore a localised increase in growth immediately above the cuts, and a complementary starvation below them.

* Journal of the Rubber Research Institute of Malaya, Vol. 8, No. 1, pages 34-38.

It was with a view to determining whether the same effect occurred in the experiment under review that the figures for 1938 were divided into two groups as described above, and the results are shown in Table VIII. A glance will show that the differences between the several systems are exceedingly small and of no consequence. There is, however, a slight indication of the effect noted in Malaya. Grouping the figures for the single-cut systems and the double-cut systems together (including No. 3 with the double-cut systems) we find that the averages are :

	Above Cut	Below Cut
Single-cut systems	5·7 mm. ...	6·0 mm.
Double-cut systems	5·9 „ ...	5·9 „

A similar analysis of the 1939 figures showed even smaller differences.

The apparent discrepancy between these results and those obtained in Malaya is probably due to the fact that whereas in Malaya each panel on a single-cut system is tapped right out, in the experiment under review a change of side is made every six months. This difference affects the results in two ways :

(1) In the experiment on Dartonfield the trees on a single-cut system have been tapped on both sides during the year of renewal. Thus although only one panel is tapped at a time there is some interference with the movement of food substances on both sides of the tree.

(2) In the Malayan experiment the conclusion that the renewal at the base of the tree was slower with double-cut than with single-cut systems was based on measurements made on the panel opposite to that tapped on the single-cut systems. This obviously places the single-cut systems at an advantage over the double-cut systems which would not be applicable to Ceylon where an annual or six-monthly change of panel is the general custom.

It may thus be concluded that under the conditions of the experiment the rate of renewal at the base of the tree is entirely satisfactory with double-cut as well as with single-cut systems. The good agricultural condition and excellent rate of renewal in the experiment areas must, however, be stressed, and it is not known whether the same result would be obtained with rubber of poorer class.

Brown Bast.—Table X gives the number of trees affected by Brown Bast in June, 1938, and June, 1939. The total number of trees tapped by each method is 180.

TABLE X

Number of Trees with Brown Bast

Tapping System	Number of trees with Brown Bast	
	June, 1938	June, 1939
1. ½ sp.a.d.	6	6
2. ½ sp.a.d. A.B.C. 12/6	0	2
3. ½ sp.a.d. alt. sides	3	5
4. 2×¼ sp.a.d....	2	4
5. D/4	3	5
6. D/4 A.B.C. 12/6	0	4
7. ½ sp. 3. d.	3	3
8. D/3	8	11
9. D/3 A.B. 6/6	4	6
10. D/3 A.B.C. 12/6	4	5
11. D/3 A.B.C. 8/4	3	5
Total	36	56

The outstanding fact shown by these figures is the relatively large number of cases in the plots tapped on System No. 8.

Acknowledgment

The assistance given by the Statistical Department of the Rothamsted Experimental Station in the lay-out of the experiment and statistical computation of the results is gratefully acknowledged.

THE PERFORMANCE OF IMPORTED CLONES IN CEYLON—III.

C. E. FORD, *Geneticist*

Introduction

THE Research Scheme continues to receive yield records of various imported clones from several Ceylon estates, whose co-operation is gratefully acknowledged. Those relating to the year 1938 (in some cases the tapping year 1938-39) are reported in this article, the third of its series.

Presentation of Results

With one exception all the figures given below are derived from the test tapping of groups of trees rather than the commercial tapping of whole clearings. It should be noted that the results of test tapping may only be taken as truly representative when a random sample of the whole area is tapped. The selection of trees for tapping has not been under the control of the Research Scheme and therefore all the records cannot be regarded as of equal value.

The results are presented in essentially the same form as in the previous article of the series. In Table II are given the records from estates where comparisons between several clones growing under similar conditions can be made ; in Table III all the available data are grouped by clones. All the yield figures given in Table II and most of those in Table III are the actual yields of dry rubber obtained in one year. The remaining entries in Table III are estimated figures for one year derived from yield records of a shorter tapping period.

This year the yield figures obtained from Area 6 on the Iriyagama Division of the Experiment Station, Peradeniya, are presented in a separate Table I.

The yields of the original buddings in the countries of their origin are again given in Table IV for comparison.

Unless otherwise stated, all tapping is on half spiral on alternate days.

Notes on Tables

General.—Full notes on a number of the areas from which records have been received were included in the previous article of the series (R.R.S. Quarterly Circular, Part 2, 1938). These are briefly recapitulated here and similar notes are added on several further areas.

Since the publication of the last article of the series it has been found that a number of clones whose yields were recorded therein contain a considerable proportion of rogues. These records are, therefore, unreliable and have not been included in this report. They are as follows :—Estate F, all except TJ. 1, TJ. 16, P.B. 86, P.B. 180 and B.D. 2 ; Estate H, B.D. 10 ; and Estate P, A.V.R.O.S. 163 and CT. 88.

The letters given to the various estates are the same as those used last year.

Iriyagama Division, Experiment Station, Peradeniya.—The area from which the figures are taken is laid out as a randomised plot experiment with five replications and hence affords a critical comparison between the various clones. The total planted area is $5\frac{1}{2}$ acres ; seven "trial" clones are included, with Clone Heneratgoda 2 and unselected seedlings as controls ; each plot contains twelve trees and each clone occupies an area of 0·6 acre. The planting density works out at 100 trees to the acre.

Tapping was commenced in July, 1937, when all trees of tappable size were taken in except in plots where less than six trees were of the requisite girth. Such plots were not tapped at all. Yields are expressed on a per acre basis as it is considered that this gives a more reliable indication of a clone's commercial performance since it takes into account differences in the proportions of tappable trees. Up till the end of December, 1937, the tapping system was a half spiral cut on alternate days ; as from the beginning of January, 1938, it was changed to a half spiral cut every third day. In July, 1938, further plots and trees which had reached the required standards were taken into tapping.

Taking into account the third-day tapping the yields of clones TJ. 1 and TJ. 16 must be considered satisfactory, especially in comparison with the seedlings, whose poor performance would seem to indicate that the general level of yield in the area is low. The performance of the remaining clones is disappointing, though it should be noted that in most cases the percentage of trees in tapping in the first half of the year was low. Clones B.D. 5 and S.R. 9 have received rather unfavourable treatment in this respect since certain trees could have been tapped in the first six months had the particular plots contained the requisite number of six tappable trees.

Estate B, Kalutara District.—On this estate a comparison can be made between the records of imported and local clones under similar conditions. The yields of six of these local clones are included and, with the exception of Heneratgoda 2, compare favourably with those of the four imported clones, though it should be noted that the three Millakande clones are a year older than the remainder.

The yield of the TJ. 1 trees is satisfactory considering that they are tapped on a third circumference; the B.D. clones, however, are very disappointing, even taking into account the fact that they are less favourably situated than the others.

Estate D, Kalutara District.—These yields refer to the tapping year April, 1938, to February, 1939, during which approximately 80 per cent. of the total stand was tapped.

As explained in the previous report the somewhat low general level of yield may be accounted for by the rather unsatisfactory past history of this area; all clones, however, have shown a satisfactory increase over the 1937 figures.

Estate E, Kurunegala District.—The two clones in test tapping on this estate, TJ. 16 and A.V.R.O.S. 49, have both given considerable yield increases in 1938. The performance of TJ. 16 in particular must be considered highly satisfactory.

Estate F, Kegalle.—This area was planted in 1930 on poor soil. In January, 1937, all trees which had reached the requisite girth were taken into test tapping. Consequently the yields are of the biggest trees and are not representative of the stand as a whole.

The yields of TJ. 1 and B.D. 2 show a decrease as compared with 1937, for which the Superintendent is unable to provide an explanation.

Estate P, Kurunegala.—An area of five acres of good jungle soil was planted with budded stumps of several imported clones in September, 1930. Ten selected trees of each clone were test tapped in 1937-8 and gave very good yields. All trees of the requisite girth were tapped as from March 1st, 1938. As a consequence of the proportionally large number and smaller girth of the extra trees the yield per tree of all clones has shown a decrease in 1938.

As is usual in the drier districts TJ. 16 has yielded very well, the figure of 11.2 lbs. per tree being more than half as much again as that of any of the other clones.

Estate U, Matale District.—This estate is situated in an extremely dry locality, the rainfall during the last tapping year being only 45 inches, of which 27 inches fell in two months. The test tapped area was planted with budded stumps of 12 imported clones in 1929-30. Growth has been slow and tapping was only commenced in April, 1938. Reference to Table III shows that the yields are rather low in relation to the age of the trees, but they are not unsatisfactory for the locality.

It is of interest to note that in these conditions B.D. 5 has shown the best growth of all the clones. Also that TJ 16 does not show up so well as is usual in the drier districts.

Wagolla Practical Farm School, Kegalle.—This is an area of about five acres which was planted with budded stumps of imported and local clones in 1927-28. The general yield level is exceptionally high. This is partly due to the very wide spacing of the trees and to the fact that the soil is a rich alluvial loam. The present stand is of 197 trees.

The yields of B.D. 5 and B.D. 2 are very good but B.D. 10 and A.V.R.O.S. 49 do not seem to be suited to the locality.

Estate L, Ratnapura District.—These figures are from an area of about one acre which was planted with budded stumps in 1930. The stand now consists of 76 trees, 6 of which have been pollarded for budwood. Tapping of 41 selected trees commenced in April, 1935, and of the remaining 29 in January, 1938. This increase in the number of trees tapped accounts for the slight fall off in yield per tree recorded for the year 1938. The figure of 10·9 lbs. per

tree at eight years old is nevertheless very satisfactory. The yield of the whole block for the period was 726 lbs.

There have been two cases of Brown Bast and nine of wind damage in the area.

Estate T. Kalutara District.—The TJ. 1 yield record from this estate is of interest as it is taken from the commercial tapping of a 9-acre block. The area was budded in the field in 1931-32. Trees with a girth of 21 inches or over were taken into tapping at the end of July, 1938, on the half spiral alternate daily system; from the middle of September the system was changed to half spiral third day. The actual yield per tree tapped for the period of five months was 2·7 lbs., giving a yield of 192 lbs. per acre. The number of trees tapped per acre averaged 72.

Notes on Individual Clones

Full notes on the clones of main importance were given in the last report of this series, and only fresh developments of interest are recorded below.

Tjirandji 1.—Reference to Table III will show that on some estates the yield has shown a decrease as compared with the previous year. On Iriyagama this is due to the change from alternate day to third-day tapping and on estate L to the inclusion of a number of smaller trees in the test tapped group, but on estates F, H and R the decrease is a real one. On estates H and R it is due to the occurrence of Brown Bast but no explanation can be given for the decrease on estate F. It is becoming increasingly clear that on the half spiral alternate day system there is a danger of an unduly large proportion of trees developing this disease. A large scale experiment to determine the best method of tapping trees of this clone has recently been started.

Cases of severe wind damage have been reported during the year in low-lying areas where the growth has been very rapid and on the unprotected boundary of monoclone blocks, but on exposed hill slopes, where the early growth is relatively slow, injury of this nature is not extensive. It is believed that the danger of wind damage can be largely mitigated by pruning the "master" branch, preferably in the third year of age. Care should also be taken not to

over-stimulate the growth of young trees of this clone by excessive fertiliser applications.

Tjirandji 16.—The yield of this clone shows an increase as compared with the previous year on every estate except P, where the records for 1937 were derived from the ten biggest trees in the group. The performance of TJ. 16, particularly in the drier localities, is most encouraging, and bark renewal is particularly good.

Bodjong Datar 5.—The yields of this clone are rather disappointing except at Wagolla and on estates P, S and U, all of which are in relatively dry districts. Although we have considerable confidence in the ultimate value of areas planted with this clone, the trees give a poor return in the early years except where they are planted on good soil. It is now recommended that the use of B.D. 5 be mainly restricted to the deep, fertile soils characteristic of some of the drier districts.

Bodjong Datar 10.—It is interesting to note that whereas at Wagolla the yield of B.D. 10 is low in relation to B.D. 5 and other tested clones, on estate D, in an area of poor soil, this clone is so far superior to both B.D. 5 and Tjirandji 16. This illustrates the importance of selecting clones suited to the environment, and stresses the value of records such as are presented in this paper. In general the performance of this clone is rather disappointing.

A.V.R.O.S. 49.—Except on estate E the yields are low, and nowhere has this clone displayed the productive capacity recorded in other countries. The same remarks apply to most of the A.V.R.O.S. clones.

A.V.R.O.S. 152.—Judged by the limited records available this is the highest yielding of the A.V.R.O.S. clones, but in other countries it has been found to be markedly susceptible to soil conditions.

Prang Besar 23.—The yield of ten trees at Nivitigalakele showed a big increase as compared with 1937, but the clone is no longer considered to be of much interest in Malaya.

Prang Besar 25. The performance of this clone at Nivitigalakele continues to be rather disappointing, but this is doubtless partly due to the poor soil in which the trees are growing.

Present Recommendations

The only departure from the list of imported clones recommended for extensive planting, which was given in the last report of this series, is that Prang Besar 186 is no longer advocated except on estates where previous experience has shown that the bark characteristics are satisfactory. This clone has recently fallen into disfavour in Malaya on account of protuberant buds on the tapping panel and rough renewal. At Nivitigalakele, where a plot has recently been taken into test tapping, the trees do not display the former characteristic to any marked degree, and it seems likely that the clone may prove quite suitable for use under certain conditions. Extensive planting cannot, however, be approved until observations on bark renewal have been made.

The following newer N.E.I. clones are also recommended for planting within the limitations mentioned :—

A.V.R.O.S. 255.—This is the best of the newer A.V.R.O.S. clones. Its yield and secondary characteristics on the A.V.R.O.S. Station have been very satisfactory, but since no observations have yet been made on its growth in Ceylon we hesitate to recommend its use except on a relatively small scale.

A.V.R.O.S. 352.—On the A.V.R.O.S. Station this clone attained the exceptionally high yield of 26·4 lb. in the seventh year of age, but it has had to be discarded in that country on account of excessive wind damage. This may not prove to be such a serious factor in Ceylon and it is well worth planting on a small scale.

P.R. 107.—This clone has a very satisfactory history in Java. It is believed to be represented on only one estate in Ceylon, and here the growth and early test tapping yields are promising. Further knowledge of this clone will be available by the time that there are sufficient supplies of planting material in Ceylon for extensive use.

TABLE I

YIELDS OF IMPORTED CLONES AT IRIYAGAMA DIVISION, EXPERIMENT STATION, PERADENIYA, 1938.

TAPPING ON HALF SPIRAL THIRD DAY

Clone	Total Yield in lbs. for 5 plots (= 0.6 acres)	Percentage trees in tapping		Yield in lbs. per acre for year
		Jan.-June	July-Dec.	
TJ. 16	301	87	95	502
TJ. 1	285	92	97	476
TJ. 8	194	65	93	324
A.V.R.O.S. 49	153	90	98	255
A.V.R.O.S. 50	121	73	90	202
B.D. 5	111	37	87	186
H. 2	104	50	85	173
S.R. 9	89	0	80	148
Seedlings (unselected)	83	92	98	139

TABLE II

YIELDS OF IMPORTED CLONES ON CEYLON ESTATES, GROUPED BY ESTATES. TAPPING ON HALF SPIRAL ON ALTERNATE DAYS.

Estate	B		D		E	
District	Kalutara		Kalutara		Kurunegala	
Annual rainfall in inches	174		146		87	
When budded or planted	June, 1930. Budded in field		1930. Budded stumps		May-June, 1931. Budded in field	
Period of tapping	1938		April, 1938-February, 1939		March, 1938-February, 1939	
Yield in lbs. per tree for period stated. Number of trees tapped in brackets	(10) TJ. 1	8·0*	(44) B.D. 10	5·9	(100) TJ. 16	9·9
	(10) B.D. 10	4·4	(80) TJ. 16	5·8	(100) A.V.R.O.S. 49	6·4
	(10) B.D. 5	4·2	(25) B.D. 5	5·5		
	(10) B.D. 2	3·7	(59) A.V.R.O.S. 49	4·5		
	(10) *Hillcroft* 28	11·9	(61) A.V.R.O.S. 50	4·3		
	(10) *Hillcroft* 55	7·0	(94) DJ. 1	2·5		
	(10) *Heneratgoda* 2	3·9				
	(10) *Millakanda* 3/2†	9·4				
	(10) *Millakande* 4/3†	7·1				
	(10) *Millakande* 1/1†	8·4				

* Tapped on 1/3 circumference

† Budded in 1929

TABLE II—(*Contd.*)

Estate	F		N		P	
District	Kegalle		Kalutara		Kurunegala	
Annual rainfall in inches	136		155			
When budded or planted	September, 1930		1930. Budded in field		1930. Budded stumps	
Period of tapping	March, 1938-January, 1939		1938		March, 1938-February, 1939	
Yield in lbs. per tree for period stated. Number of trees tapped in brackets	(3) P.B. 86	9·4	(12) A.V.R.O.S. 152	6·8	(31-32) TJ. 16	11·2
	(25) B.D. 2	6·8	(12) DJ. 1	6·3	(46-47) B.D. 10	6·7
	(3) P.B. 123	6·7	(12) A.V.R.O.S. 80	6·1	(45-48) B.D. 5	6·6
	(29) TJ. 16	6·3	(12) TJ. 8	6·0	(19-30) TJ. 8	6·3
	(4) P.B. 23	6·1	(12) A.V.R.O.S. 49	5·7	(37-39) B.D. 2	6·2
	(38-39) TJ. 1	5·4			(43-45) A.V.R.O.S. 50	5·4
	(4) P.B. 155	5·0			(42-44) A.V.R.O.S. 152	5·2
	(3) P.B. 180	4·8			(47-48) A.V.R.O.S. 49	5·1
	(5) P.B. 24	3·2				

TABLE II—(*Contd.*)

Estate	U		Wagolla Farm School	
District	Matale		Kegalle	
Annual rainfall in inches				
When budded or planted	1929/30. Budded stumps		June/July, 1928. Budded stumps	
Period of tapping	April, 1938-February, 1939		1938	
Yield in lbs. per tree for period stated. Number of trees tapped in brackets	(32) TJ. 1	5·9	(5) B.D. 5	21·9
	(46) B.D. 5	5·0	(5) B.D. 2	18·6
	(2) B.D. 2	5·0	(1) A.V.R.O.S. 152	16·2
	(59) TJ. 16	4·6	(2) A.V.R.O.S. 71	10·2
	(5) CT. 88	3·8	(3) A.V.R.O.S. 49	9·8
	(8) A.V.R.O.S. 163	3·8	(3) B.D. 10	9·4
	(9) A.V.R.O.S. 49	3·4		
	(3) TJ. 8	3·3	(4) B.R. 1*	15·7
	(5) A.V.R.O.S. 50	2·8	(4) B.R. 2*	14·8
	(4) DJ. 1	2·7	(9) S.R. 9*	13·0
	(3) A.V.R.O.S. 152	2·4	(3) CT. 88*	11·9
	(2) B.D. 10	2·3		

* Planted October/November, 1927.

TABLE III

YIELDS OF IMPORTED CLONES ON CEYLON ESTATES, GROUPED BY CLONES. TAPPING ON HALF-SPIRAL ON ALTERNATE DAYS.

Clone	Estate	District	No. of trees	Yields in lb. per tree per annum at ages of (to the nearest half-year)																							
				4		4½		5		5½		6		6½		7		7½		8		8½		9		9½		10	
TJ. 1	Iriyagama	Kandy	55-57																	7·0				5·1*			
Do	A	Kalutara	200									7·2															
Do	B	Kalutara	10	2·3				3·7				6·5				5·9†				8·0†							
Do	C	Ratnapura	12									6·6				8·3											
Do	F	Kegalle	36-39													7·4				5·4							
Do	G	Galle	60											6·5													
Do	H	Ratnapura	400‡													8·1				7·5							
Do	H	Ratnapura	400‡													6·4											
Do	I	Kalutara	32											6·8				9 7				11·8					
Do	J	Kegalle	46-45																	7·0				7·0			
Do	K	Kalutara	3-10	3·0				4·6				4·9				6·6											
Do	L	Ratnapura	41-70									6·5				11·8				10·9							
Do	R	Ratnapura	240-200									9·0				6·1											
Do	T	Kalutara	627											5·4*													
Do	U	Matale	32																			5·9					
TJ. 8	Iriyagama	Kandy	39-56																	4·0				3·9*			
Do	N	Kalutara	12									2·6				3·6				6·0							
Do	P	Kurunegala	10-30													9·7				6·3							
Do	U	Matale	3																			3·3					
TJ. 16	Iriyagama	Kandy	52-57																	5·5				5·5*			
Do	D	Kalutara	77-80													3·6				5·8							
Do	E	Kurunegala	100											6·6				9·9									
Do	F	Kegalle	21-29													6·1				6·3							
Do	H	Ratnapura	400													5·4											
Do	I	Kalutara	29-28							5·5				7·2				8·2									
Do	O	Kalutara	29-30															8·5				9·6					
Do	P	Kurunegala	10-32													13·8				11·2							
Do	U	Matale	59																			4·6					

*Tapped on ½ sp. 3 d. †Tapped on 1/3 sp.a.d. ‡Two different areas.

TABLE III—(*Contd.*)

Clone	Estate	District	No. of trees	Yields in lb. per tree per annum at ages of (to the nearest half-year)																			
				4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11	11½				
B.D. 2	B	Kalutara	10	—	—	—	—	3·0	—	4·8	—	3·7											
Do	F	Kegalle	22-25	—	—	—	—	—	—	7·6	—	6·8											
Do	P	Kurunegala	10-39	—	—	—	—	—	—	9·0	—	6·2											
Do	S	Matale	4	—	—	—	—	—	—	—	—	5·2*	—	6·8*									
Do	U	Matale	2	—	—	—	—	—	—	—	—	—	5·0										
Do	Wagolla	Kegalle	5	—	—	—	—	—	—	—	—	—	—	—	18·3	—	18·6						
B.D. 5	Iriyagama	Kandy	22-52	—	—	—	—	—	—	—	—	3·8	—	2·6*									
Do	A	Kalutara	200	—	—	—	—	4·7															
Do	B	Kalutara	10	—	—	—	—	3·3	—	4·7	—	4·2											
Do	C	Ratnapura	12	—	—	—	—	—	—	4·4													
Do	D	Kalutara	19-25	—	—	—	—	—	—	4·0	—	5·5											
Do	G	Galle	60	—	—	—	—	—	4·5														
Do	K	Kalutara	10	—	—	—	—	3·8	—	5·2													
Do	P	Kurunegala	10-48	—	—	—	—	—	—	9·7	—	6·6											
Do	S	Matale	14-22	—	—	—	—	—	4·0*	—	4·7*												
Do	R	Ratnapura	200	—	—	—	—	—	—	5·2													
Do	T	Kalutara	20	—	—	—	—	—	3·6*														
Do	U	Matale	46	—	—	—	—	—	—	—	—	—	5·0										
Do	Wagolla	Kegalle	5	—	—	—	—	—	—	—	—	—	—	—	19·8	—	21·9						
B.D. 10	A	Kalutara	200	—	—	—	—	4·0															
Do	B	Kalutara	10	—	—	—	—	3·1	—	4·9	—	4·4											
Do	D	Kalutara	29-44	—	—	—	—	—	—	4·7	—	5·9											
Do	P	Kurunegala	10-47	—	—	—	—	—	—	9·2	—	6·7											
Do	S	Matale	5	—	—	—	—	—	—	—	—	3·5*	—	5·9*									
Do	U	Matale	2	—	—	—	—	—	—	—	—	—	2·3										
Do	Wagolla	Kegalle	3	—	—	—	—	—	—	—	—	—	—	—	7·2	—	9·4						

*Tapped on ½ sp. 3 d.

TABLE III—(*Contd.*)

Clone	Estate	District	No. of trees	Yield in lb. per tree per annum at ages of (to the nearest half-year)																			
				4		4½		5		5½		6		6½		7		7½		8		8½		9	
A.V.R.O.S. 49	Iriyagama	Kandy	54-59	—		—		—		—		—		—		—		—		3·5		—	2·7*
Do	A	Kalutara	200	—		—		—		—		3·1											
Do	C	Ratnapura	12	—		—		-		—		—		—		3·2							
Do	D	Kalutara	51-59	—		—		—		—		—		—		2·9		—		4·5			
Do	E	Kurunegala	100	—		—		—		—		—		4·7		—		6·4					
Do	G	Galle	60	—		—		—		—		—		4·1									
Do	N	Kalutara	12	—		—		-		—		3·4		—		3·8		—		5·7			
Do	P	Kurunegala	10-48	—		—		—		—		—		—		7·8		—		5·1			
Do	U	Matale	9	—		—		—		—		—		—		—		—		—		3·4	
Do	Wagolla	Kegalle	3	—		—		—		—		-		—		—		—		—		—	6·0
A.V.R.O.S. 50	Iriyagama	Kandy	44-54	—		—		—		—		—		—		—		—		3·5		—	2·4*
Do	A	Kalutara	200	—		—		—		—		3·8											
Do	C	Ratnapura	6	—		—		—		—		—		—		2·6							
Do	D	Kalutara	50-61	—		—		—		—		—		—		3·1		—		4·3			
Do	P	Kurunegala	10-45	—		—		—		—		—		—		7·4		—		5·4			
Do	U	Matale	5	—		—		—		—		—		—		—		—		—		2·8	
A.V.R.O.S. 71	Wagolla	Kegalle	2	—		—		—		—		—		—		—		—		—		—	8·2
A.V.R.O.S. 80	N	Kalutara	12	—		—		—		—		3·0		—		4·1		—		6·1			
A.V.R.O.S. 152	N	Kalutara	12	—		—		—		—		3·5		—		5·4		—		6·8			
Do	P	Kurunegala	10-48	—		—		—		—		—		—		6·9		—		5·1			
Do	U	Matale	3	—		—		—		—		—		—		—		—		—		2·4	
Do	Wagolla	Kegalle	1	—		—		—		—		—		—		—		—		—		—	14·8
A.V.R.O.S. 163	U	Matale	8	—		—		—		—		—		—		—		—		—		3·8	
A.V.R.O.S. 256	C	Galle	60	—		—		—		—		—		2·7									

Clone	Yield in lb. per tree per annum at ages of (to the nearest half-year)																						
	9½		10		10½		11		11½														
A.V.R.O.S. 49	—		—		—		—		—														
Do																							
Do																							
Do																							
Do																							
Do																							
Do																							
Do																							
Do																							
A.V.R.O.S. 50	—		—		—		—		—														
Do																							
Do																							
Do																							
Do																							
Do																							
A.V.R.O.S. 71	—		—		—		—		—														
A.V.R.O.S. 80																							
A.V.R.O.S. 152																							
Do																							
Do																							
Do	—		—		—		—		—														
A.V.R.O.S. 163																							
A.V.R.O.S. 256																							

*Tapped on ½ sp. 3 d.

TABLE III—(*Contd.*)

No. of years	Yield in lb. per tree per annum at ages of (to the nearest half-year)																					
	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11	11½
46-19	—	—	—	—	—	—	1·2	—	2·5							
12	—	—	—	—	—	3·0	3·6	—	5·6							
10	—	—	—	—	2·4	0·5	—	1·6	—	4·6*						
4	—	—	—	—	—	—	—	—	—	1·2						
5	—	—	—	—	—	—	—	—	—	3·8						
3	—	—	—	—	—	—	—	—	—	—	—	—	13·7	—	11·6	
10	—	—	—	1·3	—	2·7	—	7·5								
4	—	—	—	—	—	—	—	—	1·9							
3	—	—	—	3·7	—	3·6	—	5·5	—	6·4						
5	—	—	—	—	—	—	—	—	—	3·2						
9	—	—	—	—	1·4	—	3·9	—	5·6							
3	—	—	—	5·1	6·8	—	8·2									
3	—	—	—	—	—	—	8·6	—	9·4							
3	—	—	—	—	—	—	—	—	6·7							
4	—	—	—	—	—	—	—	—	5·0							
2-3	—	—	—	—	—	—	3·5	—	4·8							
9	—	—	—	—	—	—	—	—	—	—	—	—	12·0	—	13·0	
48	—	—	—	—	—	—	—	—	—	—	3·1*					
4	—	—	—	—	—	—	—	—	—	—	—	—	12·7	—	15·7	
4	—	—	—	—	—	—	—	—	—	—	—	—	16·8	—	14·8	

*Tapped on ½ sp. ½ d.

Clone	Year planted or budded	No. of trees	4½	5	5½	6
T.J. 1	1920	2	—			
T.J. 16	1920	9	—			
B.D. 5	1918	7				
B.D. 10	1918	40				
Djasinga 1	1920	135				
A.V.R.O.S. 49	1919	4		3·1		6·4
P.B. 25	1922	10				12·4
P.B. 86	1923	10	10·2		12·3	
P.B. 186	1922	10		—		11·2
Glenshiel 1	1921	20	—		—	
Pil. B. 84	1924	18	5·3		7·0	
Pil. D. 65	1924	5	4·4		11·0	

TABLE IV

YIELD OF ORIGINAL BUDDINGS IN COUNTRIES OF ORIGIN

Yield in lb. dry rubber per tree at ages of (to nearest half-year)

7		8		9		10		11		12		13		14		15		16		17		18		19
6½		7½		8½		9½		10½		11½		12½		13½		14½		15½		16½		17½		18½	
—		—		30·6		26·6		35·2		41·4		33·4		42·9		39·6		42·5		86·2		62·5		
—		—		24·0		23·8		20·1		21·3		27·5		20·4		25·5		27·9		45·1		40·5		
	—		—		18·5		25·3		26·0		26·6		29·9		36·1		34·5		33·7		31·7		31·7		33·0
	—		—		15·7		18·9		20·0		17·8		21·1		21·8		21·3		23·1		22·8				
	—		—		9·7		11·0		15·0		14·3		17·2		19·8		24·2		23·5		20·0		16·3		
	9·2		11·4		10·6		13·2		17·2		19·6		23·1											
	13·9		15·1		20·1		22·1		22·9		—		—		—		24·1*		24·5*					
14·9		18·5		21·1		23·9		—		—		—		21·4*		23·2*								
	15·6		20·6		27·6		26·3		29·5		—		—		—		22·7*		21·7*					
10·7		11·1		22·7		22·4		22·2		25·9		22·1		20·3										
9·2		12·3		15·9		18·5		19·2		21·5		17·6												
15·8		18·9		20·0		26·0		23·2		23·0		17·6												

*Figures calculated from recent test tappings of about 60 trees of each clone

OIDIUM LEAF DISEASE IN CEYLON IN 1939.

R. K. S. MURRAY, *Botanist & Mycologist*

Foreword

THE refoliation season of 1939 was an exceptionally interesting one for the study of Oidium as it revealed new aspects of the relationship between the incidence of the disease and climatic factors. Hitherto severe attacks in the low-country had been associated with dull, wet weather which is not normal during the period of refoliation. The unusual intensity in 1938, for example, was rightly attributed to this circumstance. With the recollection of the recent drought in every mind it is hardly necessary to recall that the early months of 1939 were marked in most districts by the almost entire absence of rain from about the 25th January to the 22nd March, yet on some low-country estates, or portions thereof, the disease caused greater defoliation than ever before. The explanation would seem to lie in the exceptionally low range of minimum temperatures experienced in January and February, and the main purpose of this report is to amplify this statement and discuss the possible repercussions on our recommendations for control measures in the low-country.

Incidence of Disease

At the beginning of the year the writer was engaged on urgent work which did not permit him to undertake many circuit tours. Personal observation was therefore mainly confined to Dartonfield and neighbouring estates, but subsequent correspondence and conversation with planters suggests that local experience was fairly representative of most low-country districts. The following notes describe the course of events on Dartonfield and should be read in conjunction with the graphs of maximum and minimum temperatures and rainfall in January and February.

The North-East Monsoon of 1938 did not bring its normal quota of rain, and the trees started to winter unusually early. No rain was recorded from the 31st December to the 8th January, and this dry spell was responsible for rapid discolouration and fall of the old leaves. On the 12th January, soon after a short spell of very low minimum temperatures and an overcast day (11th) on which the shade temperature never rose above 72·9° F, Oidium was first noticed in an active sporulating condition on the young leaves of an isolated early-wintering low branch. (Specimens were received from an estate in the Kelani Valley a few days earlier). A spell of showery weather with occasional overcast days ensued from the 9th-25th January. The disease continued to be in evidence during this period but made no appreciable progress in the absence of much young leaf. By the end of the month most of the trees were in the early stages of refoliation, and during the first few days of February the mildew started to cause leaf-fall. At this stage sulphur dusting operations were commenced on Dartonfield, which checked the progress of the disease over the greater part of the estate.

The periods—26th January-14th February and 23rd February-1st March—were bright and sunny and free from rain. On the intervening days 3·87 inches were recorded, of which 2·17 inches fell in 24 hours, but this comparatively wet spell was not experienced in many other localities. Several days before this rain occurred heavy fall of young leaf was taking place on portions of Dartonfield and neighbouring estates, and this defoliation continued throughout March, which was also a dry month. The point to be noted is that the disease had become virulent *before* the rains were experienced, and continued to be such throughout succeeding dry spells.

The severity of the disease was often localised in a manner which is difficult to explain, one field or division of an estate suffering badly, while another at a similar elevation and in the same stage of refoliation was only mildly attacked. In general, fields lying at about paddy-field level escaped almost entirely, while defoliation was worst on the higher hills.

During March the appearance of many hill sides in the Kalutara, Ratnapura and Kelani Valley districts was reminiscent of the usual condition of areas at an elevation of about 1,500 ft., but the

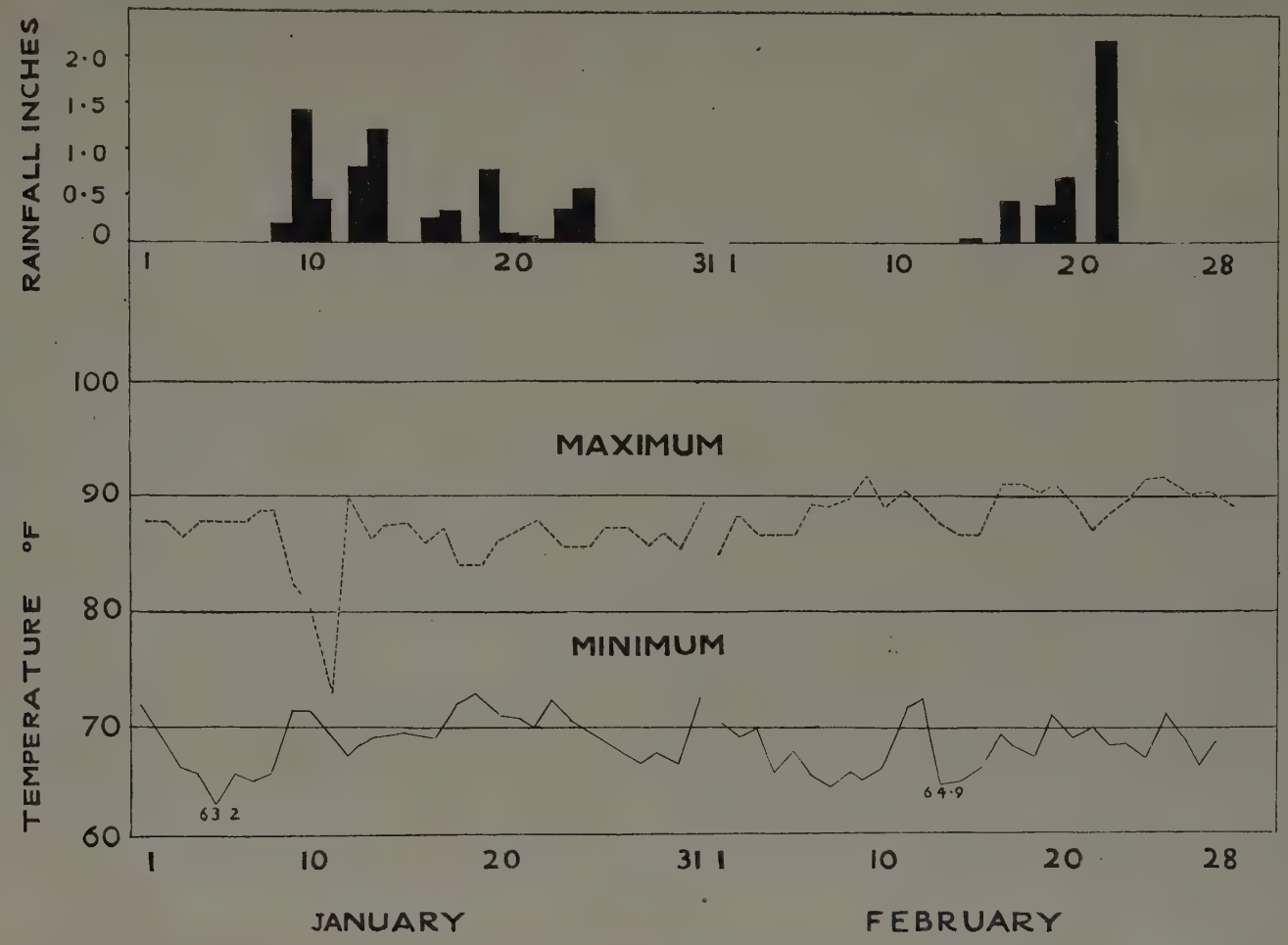

RAINFALL INCHES
2·0
1·5
1·0
0·5
0
1
10
20
31
1
10
20
28
TEMPERATURE °F
100
90
80
70
60
MAXIMUM
MINIMUM
63·2
64·9
1
10
20
31
1
10
20
28
JANUARY
FEBRUARY

FIGURE I.

foliage recovered well in April. The mildew, however, was still in evidence on young budgrafts on Dartonfield up to the end of that month.

Turning to mid-country districts, the writer only had the opportunity of making extensive observations in Matale. After an extremely dry year rain was experienced in the middle of January, but this, although very welcome from other points of view, interfered to some extent with sulphur dusting and resulted in the earliest wintering trees suffering a certain amount of defoliation. From about the 25th January onwards, however, the weather again became exceedingly dry. This enabled sulphur dusting operations to be conducted under ideal conditions, with the result that most estates now carry the best foliage ever seen in the district since pre-Oidium days. The abundance of flowers in certain areas up to as high an elevation as 1,600 ft. was striking testimony to the almost entire absence of the fungus. That this was largely due to the efficacy of the sulphur was shown by the contrasting condition of a few areas on which no treatment was undertaken, but the exceedingly dry conditions were doubtless partly responsible.

Meteorological Conditions

In 1932 Beeley[1] showed under laboratory conditions that the optimum temperature for the growth and sporulation of the fungus was between 56° and 62° F. Minimum temperatures within this range are occasionally attained and often approached at the highest elevations at which rubber is grown in Ceylon, and this is believed to be the main reason why Oidium is so much more severe at those levels than in the low-country.

Study of the lower line on the graph (Fig. 1) will show that on several days in January and February the minimum temperature at Dartonfield fell to the middle sixties, and comparison with the records of previous years reveals the fact that this is very unusual. On the 4th-5th January the minimum temperature was 63·2° F (62·3° on the grass), which is considerably the lowest temperature recorded at Dartonfield during any January or February. This, so to speak, gave the fungus a good start, and its exceptionally early appearance just after this cold spell has already been noted. The mean minimum temperature in February was 68·3° F, which is nearly 2° lower than

in any previous February for which records are available on either Dartonfield or Culloden (back to 1925). The absolute minimum at 64·9° (62·2° on the grass) bears a similar relation to the previous lowest. These cold spells coincided with record frosts in Nuwara Eliya, and it is also interesting to note that on the 4th-5th February the Colombo Observatory recorded a temperature of 62·6° F, which is only one degree above the lowest ever recorded at that Station.

It is, of course, normal for clear night skies to be accompanied by low temperatures in the early morning, but this is also the type of weather in which high maximum shade temperatures are usually recorded. During the months under consideration, however, the abnormally low night temperatures were not balanced by high day temperatures. The dotted line on the graph shows that during January the shade temperature never reached 90° F, and the average at 86·3° F is, in fact, the lowest recorded for this month at Dartonfield. The mean maximum in February at 89·3° F is about normal for that month.

It appears, therefore, that during the critical weeks at the commencement of refoliation after the annual winter the fungus was favoured by unusually low night temperatures, while this advantage was not offset by high day temperatures. In other words, the conditions were similar to those normally experienced at higher elevations.

Another interesting feature revealed by a study of the weather records at Dartonfield is the extremely high humidity of the atmosphere at the time of minimum temperature and also at 9.30 a.m. Despite the shortage of rain the mean percentage humidity at 9.30 a.m. was 84 per cent. in January and 80 in February. The corresponding figures in 1938, when the rainfall in these two months was much higher, are 66 and 67 respectively. A full discussion of the influence of meteorological factors on Oidium is outside the scope of this paper, but it may be mentioned that Beeley[1] ascertained the optimum humidity for the fungus to be between 75 and 80 per cent. It would therefore seem that despite the absence of rain the air was sufficiently humid for the development of the fungus. Such cold mornings are, of course, accompanied by heavy dew.

Weather conditions play their part in affecting the host as well as the fungus. If the young leaves develop and mature quickly they are susceptible to attack for a relatively short period of time, and the conditions which lead to rapid maturation are : (1) bright, sunny weather, and (2) an adequate water supply for the roots. The first of these conditions was certainly satisfied during the 1939 refoliation season, but after the failure of the N.E. Monsoon rains it is probable that in certain localities the soil became so dry that the trees had insufficient moisture for satisfactory development of the new foliage. Slow refoliation was, indeed, reported by a number of Estate Superintendents who were inclined to attribute the severity of Oidium to this circumstance. Although this may have been a contributory factor on some estates it was certainly not so on Dartonfield where the new foliage developed very rapidly.

Sulphur Dusting

As mentioned above sulphur dusting was extremely successful in the Matale District, but the results on some low-country estates were disappointing. In certain instances the failure could be ascribed to such factors as poor quality sulphur, insufficient rate of application, too late a start or inadequate supervision, but in others it is difficult to provide an explanation. The results on Dartonfield, for example, were patchy, and a report was received from one Superintendent, who had the paradoxical experience of achieving almost complete control at an elevation of up to 2,300 ft., but had disappointing results lower down on the same hillside. It is possible that a study of localised differences in meteorological conditions, particularly humidity, might shed interesting light on this problem.

Recommendations for the Future

The important question now arises as to whether our recommendations for control measures in the low-country should be modified in the light of recent experience. As has been explained in previous publications, the advisability of sulphur dusting is complicated in the S.W. Monsoon zone by the fear of increased Phytophthora consequent on the protection of the flower from Oidium and the subsequent abundance of pods. The present position may be stated by quoting the following extract from the Report of the Botanist & Mycologist for 1936.[2]

" Since it is impossible to predict the weather conditions—and thus the intensity of Oidium attack—during the refoliation season, the recommendation now made for low-country districts is that estates which normally experience appreciable leaf fall should possess the necessary equipment and sulphur to cope with a bad attack, but that no hard and fast programme should be laid down in advance.

" The first application should not be made until the earliest signs of crinkling of the young leaf are evident, and subsequent procedure must be dependent on the course of refoliation and the weather conditions obtaining. In this way the estate is safeguarded against severe defoliation, and it is believed that if the superintendent uses his sulphur with discretion the danger of a subsequent attack of Phytophthora should be greatly reduced. Any sulphur not used can be kept until the following year."

It has been made clear in the foregoing discussion of meteorological factors that the low temperatures experienced in January and February, 1939, to which the severity of the disease is attributed, are abnormal, and inasmuch as they are unlikely to recur frequently there would seem to be no *a priori* reason for advocating more stringent measures. The occurrence of unusually cold spells during or shortly before refoliation must be recognised as a warning that conditions may be suitable for a severe outbreak of the disease, and that an increased quantity of sulphur may have to be used.

In previous papers on the subject the importance of making the first application of sulphur before any appreciable fall of young leaf had occurred was emphasised, and there was at first a tendency for estates to start earlier than necessary. In 1939, however, the opposite trend was noted, the commencement being sometimes delayed until there was a carpet of young leaves on the ground. Rounds of dusting were then carried out with as small a quantity as 2 or 3 lb. per acre, and the results were naturally disappointing.

One of the chief grounds for criticism of dusting operations on estates is the lack of elasticity in the programme. The incidence of the disease cannot be predicted months in advance, and whereas in one year it may only be necessary to make two or three applications at 2 lb. per acre each, in the next season five rounds may be required

at double the dose. Similarly the higher portions of the estate may need two or three times as much sulphur as the lower portions.

In Leaflet No. 14[3] the basic rate advocated for low-country estates was 4 lb. per acre per application, and it is considered that any estate undertaking the treatment should carry a stock of sulphur equivalent to at least a total of 20 lb. per acre. If the conditions are unfavourable for Oidium this need not all be used, but in a bad year even 20 lb. per acre may be insufficient. The secret of successful control is to check the fungus before it can multiply itself *ad infinitum*, and if either low maximum or low minimum temperatures suggest a severe attack it would be wise to make the initial application at a relatively high rate, viz., 5 or 6 lb. per acre.

Summary

1. Severe attacks of Oidium in the low-country have hitherto been associated with unusually wet weather at the time of refoliation. In 1939 the disease caused considerable damage in certain localities despite very dry weather.

2. A study of meteorological records at Dartonfield suggests that very low minimum temperatures during January and February were responsible for the severity of the disease, the fungus being known to be favoured by low temperatures.

3. The low minimum temperatures were not offset by particularly high maximum temperatures, which might have checked the activities of the fungus.

4. Despite the dry weather the atmosphere was unusually humid in the early mornings, and this, again, favoured Oidium.

5. In the Matale district the exceedingly dry weather was ideal for sulphur dusting operations and, except at the highest elevations where no treatment was undertaken, the foliage is healthy and often very heavy.

6. Since the cold spells in January and February are unusual there is no need to modify in any important respect the present recommendations for sulphur dusting on low-country estates. Such spells should be recognised as a warning that a severe outbreak of Oidium may follow, and the first application of sulphur made at a higher rate than usual.

7. Attention is again directed to the importance of starting

the dusting programme before any appreciable fall of young leaf has occurred, and to the necessity of maintaining an elastic rather than a hard and fast programme.

REFERENCES

1. F. Beeley.—Effect of Meteorological Factors on the Virulence of Oidium Heveae in Malaya. Journal of the Rubber Research Institute of Malaya, Vol. 4, No. 2, 1932, pp. 104-114.

2. Report of the Work of the Rubber Research Board in 1936, p. 32.

3. R. K. S. Murray.—The Sulphur Dusting Treatment for Oidium. Rubber Research Scheme (Ceylon) Leaflet No. 14 (Revised Edition, 1935), p. 8.

IDENTIFICATION OF CLONES ON CEYLON ESTATES

R. K. S. MURRAY, *Botanist & Mycologist*

Object and Scope of Work

DURING the course of visits to estates towards the end of 1937 and early in 1938 it was noticed that there was often a considerable degree of confusion in both nursery and field between the various imported clones being used for replanting. As the demand which arose for the services of an officer to check the identity of clones was too great to be met by the existing Staff without dislocating the work of Senior Technical Officers, arrangements were made with the Rubber Research Institute of Malaya for the loan of one of their Chinese Budding Mandors who is experienced in this type of work.

His function was to visit any estate which made application for his services, and establish the identity of plants budded with any of the well-known clones developed in Malaya, Java and Sumatra. Particular attention was devoted to budwood multiplication nurseries since these are the sources from which future errors may arise, and on most estates each individual nursery plant was checked. Clearings were given a general inspection as far as time permitted.

Personnel

Two officers were sent from Malaya: Mr. S. Karalasingam, Laboratory Assistant, and Mr. Wong Din, Budding Mandor. The actual work of identification was carried out by Mr. Wong Din. Mr. Karalasingam was responsible for taking notes in the field and submitting a report on each estate. He also filled the essential rôle of interpreter.

Reports

From the reports furnished by Mr. Karalasingam a summarised report was prepared by the writer in respect of each estate and submitted to the Proprietor or Agent.

Period of Visit

The officers arrived in Ceylon on 11th September, 1938, and returned to Malaya on 10th February, 1939. (Mr. Karalasingam had to leave in January and his place was taken by a Ceylon-born Malay conductor).

Number of Estates

The total number of estates visited is 138. In most cases either a half or a full day was sufficient, but a few estates were visited on two or more days. A number of late applications could not be met in the limited time available. Mr. Wong Din also checked the nurseries at Nivitigalakele and carried out a general inspection of the replanted areas at Dartonfield.

Summary of Results

The figures given in Tables I and II summarise the results from multiplication nurseries and clearings respectively (excluding Nivitigalakele and Dartonfield). They should be considered in conjunction with the following notes :—

Multiplication Nurseries.

(1) No account has been taken of beds in which—

(*a*) Only a general inspection was made.

(*b*) The exact number of plants was not recorded.

(*c*) The labels had been lost.

(*d*) The clones were unknown to the officers.

(*e*) The plants were in an unsuitable condition for identification.

(2) Of the 5,217 plants incorrectly labelled, 3,308 were in beds in which the error was probably due to accidental change of labels for the whole bed at some stage in the multiplication. Thus there was one block of 3,020 plants marked TJ. 16 whereas in fact they were all TJ. 1.

Clearings.

(3) The figure of 10 per cent. taken as a demarcation of classes must be accepted with considerable reserve, as the estimate of the proportion of incorrect plants in any clearing could only be based on the results of a general inspection. Indeed the figures for the clearings are all indicative rather than absolute.

(4) No account has been taken of clearings in which—

(*a*) The acreage was not recorded.

(*b*) The plants were in an unsuitable condition for identification.

TABLE I

Multiplication Nurseries

	No.	Percentage
(1) Plants found to be correct	58,355 ...	90·4
(2) Plants found to be incorrect—		
(*a*) of other known clones	5,217 ...	8·1
(*b*) rogues, stock-shoots, etc.	949 ...	1·5
(3) Total number of plants examined	64,521	100·0

TABLE II

Clearings

	Acres	Percentage
(1) Areas in which no, or virtually no, incorrect plants were detected	5,147 ...	61·9
(2) Areas in which the proportion of incorrect plants was estimated to be *less* than 10 per cent. (either rogues or other known clones)	2,257 ...	27·1
(3) Areas in which the proportion of incorrect plants was estimated to be *more* than 10 per cent.—		
(*a*) Incorrect plants identified as other known clones	379 ...	4·6
(*b*) Incorrect plants identified as rogues, etc.	536 ...	6·4
(4) Total area inspected	8,319	100·0

Conclusions

(1) As far as individual estates are concerned the findings varied from "no incorrect plants detected" to "no single plant correct according to label." Very few estates could be placed in the former category, and the latter was represented by one estate which possessed only a small multiplication nursery laid down some years ago.

(2) In general, the results show that a great deal of confusion had arisen in the older multiplication nurseries established from budded stumps or budwood imported in about 1929-30. During the years of depression, when there was no question of using this material, labels or other marks of identification were often lost or obliterated, and when the time came for the plants to be used as sources of budwood, the attempts to decipher the identification marks met with varying success. In such nurseries, also, " false buddings," arising from stock shoots, are of not infrequent occurrence and have sometimes been propagated to establish " rogue " clones.

(3) A few instances were encountered where the original importations were almost certainly incorrect, but this source of error accounts for an insignificant proportion of the whole.

(4) The areas in which the errors are of serious economic concern can be represented by the figure of 536 acres (6·4 per cent.) in which more than 10 per cent. of the plants in the field are rogues (presumably worthless). This is fortunately a small proportion of the whole, but it is clear that, had the investigation covered by this report not been undertaken, there were vast potentialities for further mistakes. The value of this work to the local plantation industry has, therefore, been incalculable.

(5) Not the least amongst the benefits which have accrued from these officers' visit to Ceylon is the inculcation amongst Estate Superintendents of the importance of the utmost care in all stages of multiplying clones. One hopes, also, that on every estate with a planting programme being undertaken or in contemplation at least one employee will learn to be able to identify the clones which are in use.

(6) Advantage has been taken of the officers' residence at Nivitigalakele and visits to neighbouring estates to enlarge the experience of the Subordinate Staff at the Station in this type of work, so that we may be in a position to render similar service in the future.

Acknowledgment

We are greatly indebted to the Rubber Research Institute of Malaya for this very practical example of co-operation.

SYNTHETIC SUBSTITUTES FOR RUBBER.*

IN a communiqué issued through the British Rubber Producers' Research Association on 14th February, it is stated that queries have been addressed to Producers' Research Organisations concerning the influence of " synthetic rubber production " on the rubber market and rubber cultivation policy. In this connection the following reply is given :—

" The success of science in unravelling nature's secrets has been spectacular in the syntheses of naturally occurring products of every-day use. A new synthesis of any such product is of itself an achievement. With it, however, come speculations on the relative economies of the natural and artificial processes and, where an article such as plantation rubber is concerned, this problem looms large because of its enormous industrial importance."

" In recent years the study of hydro carbon chemistry relating to rubber, has been pursued assiduously and a number of products have been synthesized from simple substances, possessing in variable degrees combinations of some of the manifold properties possessed by natural rubber.

" To describe the products above-mentioned as ' synthetic rubbers ' is to use a misnomer. The alternative description ' synthetic rubber-substitutes' while truer, is still inexact, since it implies a wider utility than the products possess.

" The position briefly is, that products have been synthesized in America which possess in a limited degree the elastic and processing properties of natural rubber and, in addition, specific resistance to certain rubber solvents. These materials can therefore replace natural rubber for certain industrial applications and in that capacity are being exploited commercially.

---

*Reproduced from the Bulletin of the Rubber Growers' Association, Vol. 21, Feb., 1939.

" Further, certain products have been developed under autarchic economy in Russia and Germany. Our knowledge of the former is the less intimate but as concerns the latter, their properties in relation to oxidation (ageing), solvent and abrasion resistance, widen their possibilities of encroachment on the present preserves of the natural product. The chemistry of their production is well known ; the technological detail of the processes less well known.

" Now, commerce will resolve the question of the natural versus the synthetic in terms of service and cost. As to the former nothing has yet been produced which can assail the position of plantation rubber for general utility : as concerns the latter we know how heavily the production of the German products is subsidized. Producers are well aware of the implications of attack on the competitive strength of their industry, but in our view there are no imminent dangers, for a number of reasons, such as :—

(i) The subsidy under autarchic economy is an exceedingly heavy one and, while production costs of materials made possible by its imposition may be reduced, it must be remembered that a gradual potential downward trend in production cost is being created in the producing industry.

(ii) There are no *a priori* grounds for assuming that the natural product cannot be endowed with the complementary properties possessed of synthetics : there are, in fact, good reasons to believe that it can be so improved and claims are made, even in Germany, in this respect. This is one of the important objectives of producers' research.

(iii) The position of raw rubber as basic material for the manufacture of commercial products and/or articles not necessarily possessing the properties of rubber whereby to penetrate new industries has to be further explored.

" Producers' Research organisations are co-operating internationally and their work is making progress. While there are no royal roads to the solution of research problems, the objectives of the International organisation are clear and will be pursued with energy."

MEETINGS, ETC.

RUBBER RESEARCH SCHEME (CEYLON)

Minutes of the forty-seventh meeting of the Rubber Research Board held in the Ceylon Chamber of Commerce Building, Colombo, at 2.30 p.m. on Wednesday, 15th March, 1939.

Present: Mr. E. Rodrigo, C.C.S. (in the chair), Messrs. I. L. Cameron, L. M. M. Dias, L. B. de Mel, J.P., U.P.M., F. H. Griffith, M.S.C., R. C. Kannangara, M.S.C., J. C. Kelly, F. A. Obeyesekera, J. L. D Peiris.

Mr. T. E. H. O'Brien, Director, was also present by invitation.

Apologies for absence were received from Mr. C. H. Collins, C.C.S., Deputy Financial Secretary, Mr. L. P. Gapp, Mr. B. M. Selwyn, Mr. E. C. Villiers, M.S.C., and Mr. E. W. Whitelaw.

1. Minutes

Draft minutes of the forty-sixth meeting which had been circulated to members were confirmed and signed by the Chairman.

2. Board

(*a*) The Chairman reported that he resumed duties as Chairman of the Board with effect from 1st March, 1939.

(*b*) The Chairman also reported that:—

(1) Mr. J. C. Kelly had been re-nominated by the Ceylon Estates Proprietary Association to serve for a further period of three years with effect from 5th March, 1939.

(2) Mr. E. C. Villiers, M.S.C., had been nominated as a representative of the State Council with effect from 3rd March, 1939, in place of Mr. R. P. Gaddum who had resigned.

(*c*) Referring to the impending departure on furlough of Mr. Griffith, Mr. de Mel proposed a vote of appreciation of the valuable services rendered by Mr. Griffith as a member of the Board and as Chairman of the Experimental Committee. Mr. Obeyesekera seconded. Carried with applause.

3. Experimental Committee

Recommendations made at meeting held on 28th February, 1939 :—

(*a*) *Dartonfield Water Supply.*—Decided to augment the water supply at Dartonfield by the construction of a well in the watershed below the factory. A vote of Rs. 1,912·45 was approved to cover the cost.

(*b*) *Visiting Agent's Report.*—The Visiting Agent's report of his inspection of Dartonfield and Nivitigalakele on 28th January, 1939, was adopted and it was noted with satisfaction that he was pleased with the way the estates were being worked.

(*c*) *Training in Estate Works.*—Decided that it would not be practicable to give training in general estate works and that such training did not properly come within the scope of the Scheme's activities.

(*d*) *Additional Assistant for Chemical Department.*—Decided to authorise the appointment of an additional assistant for the Chemical Department on the usual salary scale and conditions of service for junior officers.

(*e*) *Boiler.*—The recommendation of the Committee that a new boiler be purchased at a cost of Rs. 1,650 was approved.

4. Accounts

(*a*) *Statement of Receipts and Payments of the Board* for the quarter ended 31st December, 1938, was adopted.

(*b*) *Statement of Receipts and Payments of the London Advisory Committee* for the year ended 31st December, 1938, was adopted.

(*c*) *Balance Sheet and Auditor's Report for* 1938.—The balance sheet and auditor's report for 1938 were considered and adopted. The following figures summarise the financial position :—

Income, 1938			Rs. 179,401
Expenditure, 1938 : Revenue	Rs. 165,039		
Capital	,, 51,969	,,	217,008
Available cash balance		,,	133,307

(*d*) *Over-expenditure of Votes.*—Covering sanction was given for over-expenditure of votes totalling Rs. 2,313. It was noted that the over-expenditure was covered by savings under other votes.

(*e*) *Revotes for* 1939.—Unexpended balances of 1938 capital votes amounting to Rs. 8,690 and revenue votes amounting to Rs. 294, were revoted for the current year.

(*f*) *Inventory Report for* 1938 was adopted.

(*g*) *Dartonfield and Nivitigalakele Accounts for November and December*, 1938, were tabled.

(*h*) *Investment of Funds.*—On the recommendation of the Committee appointed at the last meeting to advise on the investment of funds it was decided to con-

firm the policy laid down at a Board meeting held in October, 1937, namely, "that a sum approximating to the balance of the Depreciation and Provident Fund Reserves should be invested, provided that the sum so invested shall not exceed 50 per cent. of the Board's total funds, and that it be left to the Chairman to make suitable investments in consultation with the Deputy Financial Secretary."

The Chairman was authorised to take the necessary steps to implement the policy.

(*i*) *Employees' Provident Fund.*—Decided to amend rule 1 to provide :—

(*a*) That all employees drawing a salary of Rs. 40 per month or over shall become members of the Fund.

(*b*) That monthly paid employees on a lower salary than Rs. 40 per month may become members of the Fund after completion of a period of six months' service.

5. Reports

(*a*) Technical officers' reports for the fourth quarter, 1938, were adopted.

(*b*) Annual report for 1938 was adopted after minor alterations had been approved.

6. Staff

(*a*) *Re-engagement of Smallholdings Propaganda Officer.*—Reported that the four-year period for which Mr. W. I. Pieris had been engaged under his present agreement would expire on 31st May, 1939. Decided that Mr. Pieris be offered re-engagement for a further period of four years, and that four months' leave on full pay be granted at the termination of the present agreement. Further decided that Mr. C. A. de Silva, Assistant Botanist, should take charge of the work of the Smallholdings Department during Mr. Pieris' absence.

(*b*) *Field Assistant for Geneticist.*—Reported the appointment of Mr. E. B. Gnanaratnam as Field Assistant to the Geneticist on the usual salary scale for junior officers.

The meeting terminated with a vote of thanks to the Chamber of Commerce for the use of their Committee Room.

Research Laboratories,
Dartonfield, Agalawatta.
29th March, 1939.

"Cargilineum Mixture"

PREVENTS and cures BLACK THREAD, BLACK STRIPE, STRIPE AND PATCH CANKER, MOULDY ROT AND BARK DIEBACK and is unequalled as a dressing for tapping or pruning wounds.

It is easily applied, only penetrates the correct depth, does not wash off in rain, and, when applied, is easily visible. It waterproofs the cut, protects the delicate tissues from rain and sun, is economical in use.

A Well-known Straits Planter says:—

"It is the enemy of the bad tapper, for, when properly applied (a very thin smear) it shows up wounds and what is important, it heals them."

"CARGILINEUM" "B" is most favoured where disease is present and for use during the rains, while the "A" Mixture answers well as a preventative during dry weather. "C" Mixture is recommended for the worst attacks of Mouldy Rot.

Particulars of Packing and Prices from:—

CARGILLS

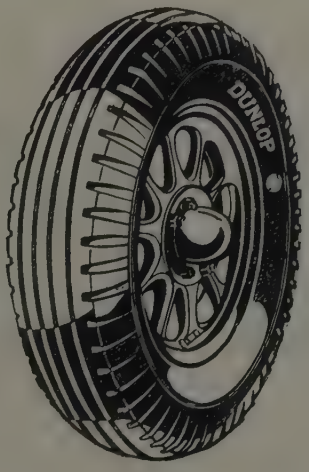
Cargills Ltd., Incorporated in Scotland. The liability of Members is Ltd.

ECONOMICAL ESTATE TRANSPORT

Save on the cost of your transport.
Save on the costs of your roads.

DUNLOP

EQUIPMENT FOR
ANIMAL DRAWN VEHICLES



For full particulars apply to:

Imperial Chemical Industries (India) Ltd.,

(Incorporated in British India. The liability of its members is Ltd.)

Post Box No. 352, Colombo

FERTILISERS

Special Mixtures for Young as well as Old Rubber

Of Special Interest to Planters:—

META—The Snail-Exterminator

PEAT MOSS for Propagation Work

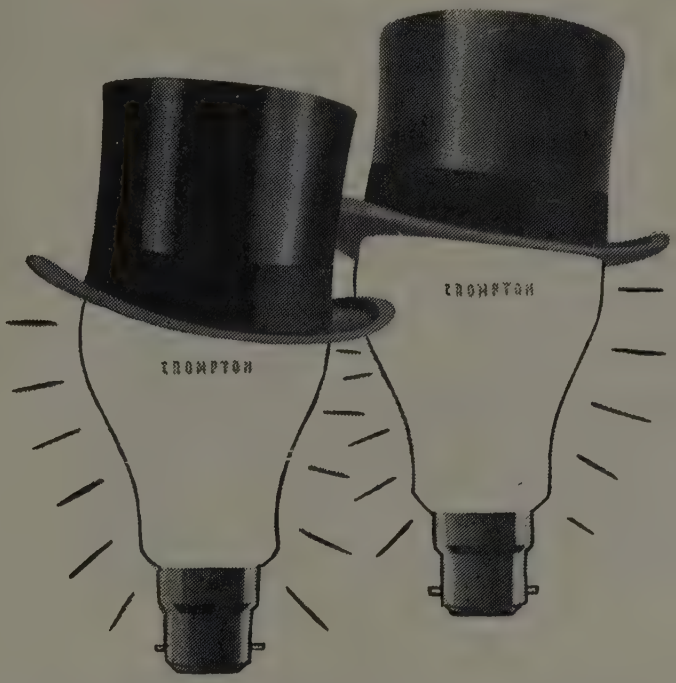
SOIL-CLEANSER, R.V.4. To rid your soil from Vermin

For Particulars and Advice write to:—

A. BAUR & Co LTD

Office: Colombo, 10, Prince St., P. O. Box No. 11. Phones 164 & 165

Works: Ceylon Manure Works, Kelaniya.



- - it's the Coiled-Coil Filament that gives the *extra* light in

CROMPTON LAMPS

The special Crompton tungsten filaments are coiled—*and coiled again*. That's why Crompton Lamps give up to one-fifth more light for the same current consumption.

Ask your dealer to-day for Crompton Lamps.

BETTER LIGHT—BETTER SIGHT

THE LAMP OF LASTING BRILLIANCE

C. E. T. & L. CO., LTD:

Agents: **BOUSTEAD BROS.**

Union Place 'Phone **4201** **Colombo.**

POTASH IS ESSENTIAL FOR BUDDED RUBBER

Without POTASH

With POTASH

Treated with Nitrogen and Phosphoric Acid.

Girth on:—
29-8-'38: 2½ ins.
6-3-'39: 3·25 ins.

Treated with Nitrogen, Phosphoric Acid and POTASH

Girth on:—
29-8-'38: 3 ins.
6-3-'39: 4·75 ins.

Photographed 6-3-'39

BUDDED—SEPTEMBER, 1937

Ensure well developed Rubber Trees by including POTASH in your young Budded Rubber FERTILISER MIXTURE.

Available from all fertiliser firms.

The Overseas Potash Export Co., Ltd.,

8, INFANTRY ROAD, BANGALORE (SOUTH INDIA.)

PROTECT YOUR RUBBER TREES

from

Black Stripe Canker (Bark Rot), Brown Bast,
Root Diseases & Pruning Wounds
by using a 3% Solution of

The Approved Water Miscible Fungicide

IZAL CAN BE APPLIED TO THE TREES IN WET OR DRY WEATHER

IZAL MIXES PERFECTLY WITH ALL WATERS

IZAL DOES NOT DAMAGE THE TENDER BARK LEFT AFTER TAPPING

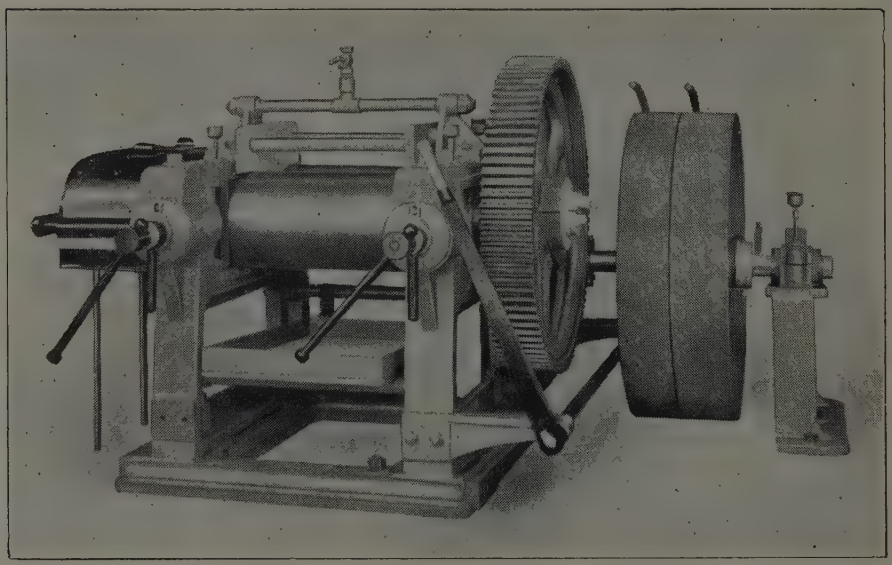
IZAL HAS NO INJURIOUS EFFECT ON THE LATEX

WALKER & GREIG LTD.

WALKERS

WASHING, CREPEING AND SHEETING

RUBBER MILL



THE design of this machine is based on practical experience gained on Rubber Estates, and it embodies improvements suggested by results obtained from previous models. Only the best materials are used in its construction. All the working parts are placed above ground level. The driving shaft and pulleys are at the back of the machine and at a height clear of all water.

MACHINE CUT GEARS—SILENT RUNNING
FITTED WITH SPECIAL SAFETY BUSHES

Full Particulars and Prices will be sent on request

WALKERS — COLOMBO.

REPLANTINGS

(SEEDLING or BUDGRAFT)

YOUNG RUBBER

AND

OLD RUBBER

ALL REQUIRE CORRECT

MANURING

THE **BEST FERTILISERS** FOR

ALL STAGES OF GROWTH

RECOMMENDED AND SUPPLIED BY

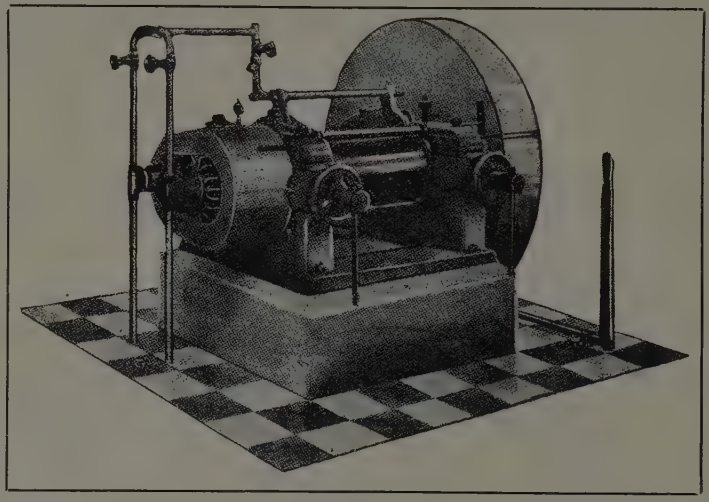
THE

COLOMBO COMMERCIAL COMPANY,

LIMITED.

(Incorporated in Great Britain—Liability of Members is Limited.)

RUBBER MACHINERY



Makers of Rubber Crepeing and Washing Mills, Scrap Washing and Sheeting Mills.

Sole Agents in Ceylon for

Messrs. David Bridge's Rubber Machinery

THE

COLOMBO COMMERCIAL CO., LTD.

Incorporated in Great Britain—Liability of Members is Limited.

COLOMBO, BADULLA, KANDAPOLA, KANDY, HATTON

THE

COLOMBO COMMERCIAL CO., LTD.

(Incorporated in Great Britain. Liability of Members is Limited).

CONTAMINATION OF RUBBER IN TRANSIT

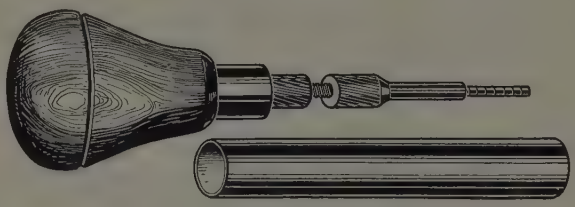
Protect your loose rubber during transport to Colombo by means of canvas bags or dust sheets as recommended by the Rubber Research Scheme in the First Quarterly Circular for 1939.

COPPER CONTAMINATION OF RUBBER CAN BE REDUCED

We carry stocks of Monel Metal Nos. 30, 40, 50 and 60 for latex sieves and it is recommended that this material be used in preference to Brass Mesh.

Write for full particulars

Hunter's Bark Gauge.



Capacity 12 Millimetres. Price Rs. 3-50

This neat little instrument will not damage the bark and is fitted with protecting cover for use when carrying in the pocket.

Other types also available, including "Pricker" pattern for conductor's use with fixed stop at 7 millimetres, complete details on request.

P.O. Box 214 **HUNTER & CO.,** **COLOMBO,**

For Estate Requirements of every description.

PARAKRAMA & Co.,

ENGINEERS

CEYLON ENGINEERING WORKS

P. O. Box 102

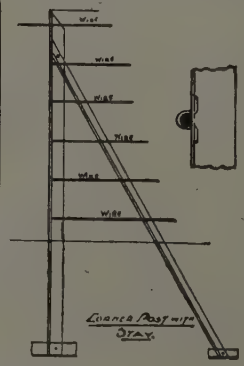
For

RUBBER FACTORIES
SMOKE HOUSES

ESTATE BUNGALOWS
LINES AND LATRINES
HAND RUBBER ROLLERS

C. I. ESTATE NAME BOARDS
REPAIRS TO MACHINERY

ALL WORK DONE UNDER
EXPERT SUPERVISION.

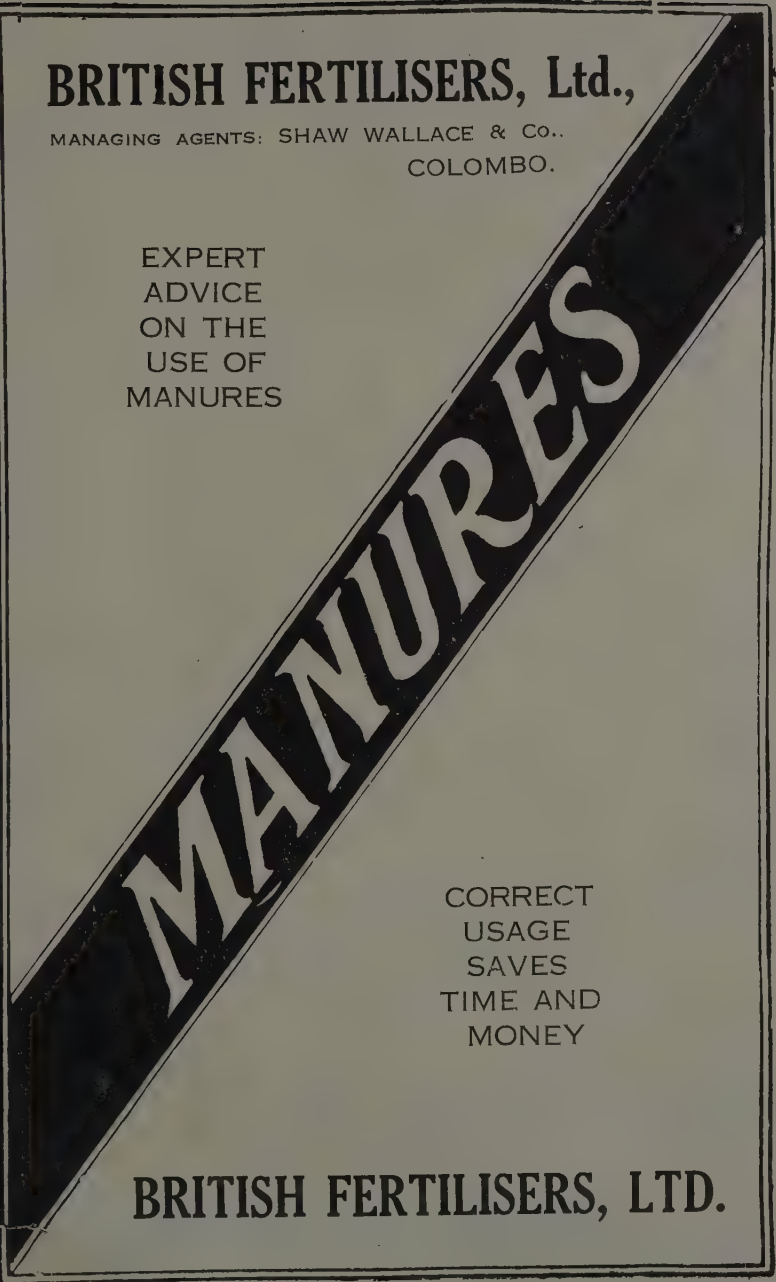


Angle Iron Fence Posts. The most durable, substantial and economical post in the Market. Painted Red, Black or Green.

BRITISH FERTILISERS, Ltd.,

MANAGING AGENTS: SHAW WALLACE & Co.,
COLOMBO.

EXPERT
ADVICE
ON THE
USE OF
MANURES



CORRECT
USAGE
SAVES
TIME AND
MONEY

BRITISH FERTILISERS, LTD.

"HENLEY" BUDDING TAPE

ADHESIVE - WATERTIGHT

Specially prepared in the Research Laboratories of Messrs. Henley's Telegraph Works, the well-known manufacturers of insulating materials.

THIS TAPE CONSISTS OF STRONG CLOSELY WOVEN FABRIC, PREPARED ON ONE SIDE WITH A SPECIAL WATERPROOF ADHESIVE COMPOUND

Very Tenacious and clean to handle

1¼ ins. wide in tins of 72 yards

Per tin Rs. 2-80

Less than 4 cts. a yard!

BROWN & CO. LTD
ENGINEERS & MERCHANTS
COLOMBO AND BRANCHES

For Rates and Particulars of Advertisements in

The Quarterly Circular

apply to:—

The Director,

Rubber Research Scheme,

Dartonfield,

AGALAWATTA.

Printed by
The Times of Ceylon Co., Ltd.,
Colombo.

London Advisory Committee for Rubber Research (Ceylon and Malaya).

Member nominated by the Colonial Advisory Council of Agriculture and Animal Health:

Sir Frank Stockdale, K.C.M.G., C.B.E.

Member nominated by the Government of Ceylon:

Dr. W. Youngman, D.Sc., Ph.D.

Member nominated by the Governments in British Malaya:

Mr. J. Lornie, C.M.G.

Members representing Malayan Planting interests—nominated by the Rubber Growers' Association:

Mr. P. J. Burgess (Chairman).
Mr. J. L. Milne.
Mr. Eric Macfadyen.

Members representing Ceylon Planting interests—nominated by the Rubber Growers' Association:

Sir Herbert Wright.
Mr. G. H. Masefield.
Mr. George Brown.

Member representing Manufacturing interests:

Lieutenant-Colonel J. Sealy-Clarke.

Ex-Officio Members:

Sir H. A. F. Lindsay, K.C.I.E., C.B.E., Director of the Imperial Institute.
Professor V. H. Blackman, Director of the Botanical Laboratories, Imperial College of Science and Technology.
Mr. S. F. Ashby, Director of the Imperial Mycological Institute.
Sir John Russell, O.B.E., Director of the Rothamsted Experimental Station.

Secretary:

Mr. J. A. Nelson, B.Sc.

The Technical Sub-Committee consists of members of the Advisory Committee with the following co-opted Members:

Mr. G. Martin (Superintendent of Rubber Investigations).
Mr. G. E. Coombs.
Mr. G. G. Balazs.
Mr. B. D. Porritt.
Mr. H. N. Ridley
Mr. W. C. Smith
Dr. H. P. Stevens
Dr. D. F. Twiss
Prof. R. G. H. Clements

STAFF.

Mr. G. Martin, B.Sc., A.I.C., F.I.R.I.
Mr. H. C. Baker, M.Sc., A.I.C., A.I.R.I.

RUBBER RESEARCH SCHEME (CEYLON)

LIST OF PUBLICATIONS FOR SALE

Bulletins No. 1-20. Bound volume, Rs. 5.00. **Later Bulletins Re. 1.00 per copy.**

No. 1. The Effect of Tapping on the Movements of Plant-Food in *Hevea Braziliensis*.
No. 2 The Effect of Tapping on the Movements of Plant-Food in *Hevea Braziliensis*.
No. 3. Seasonal Variations in the Movements of Plant-Food in *Hevea Braziliensis*, Part I.
No. 4. The Physiological Effects of Various Tapping Systems, Part I.
No. 5. Progress Report on Vulcanization Tests.
No. 6. The Physiological Effects of Various Tapping Systems, Part II.
No. 7. The Physiological Effects of Various Tapping Systems, Part III.
No. 8. Seasonal Variations in the Movements of Plant-Food in *Hevea Braziliensis*, Part II.
No. 9. Vulcanization Tests.
No. 10. Vulcanization Tests.
No. 11. Variability in Rubber Manufacture.
No. 12. Progress Report of the Rubber Research Chemist.
No. 13. Vulcanization Tests.
No. 14. On the Variation in the Number of Latex Vessels present in *Hevea Braziliensis*.
No. 15. Vulcanization Tests.
No. 16. On the Natural Clotting of Rubber Latex
No. 17. Vulcanization Tests.
No. 18. Measurements of "Bark Renewal"
No. 19. Vulcanization Tests.
No. 20. Vulcanization Tests.
No. 21. Vulcanization Tests. 1919
No. 22. Vulcanization Tests. 1919
No. 23. Vulcanization Tests. 1920
No. 24. Vulcanization Tests. 1920
No. 25. Investigations on Samples of Plantation Para Rubber from Ceylon. 1921
No. 26. Results of Trials of Ceylon Plantation Rubber for the Manufacture of Ebonite 1921
No. 27. Investigation on Samples of Plantation Para Rubber from Ceylon. 1921
No. 28. Investigations on Samples of Plantation Para Rubber from Ceylon. 1922
No. 29. Summary of the Principal Results Obtained from Investigations into the Properties of Ceylon Plantation Rubber in Relation to its Method of Preparation. 1922
No. 30. The Penetration of Disinfectant on the Tapping Cut of *Hevea Braziliensis*. 1922
No. 31. On the Occurrence of "Rust" on Sheet Rubber. 1923
No. 32. On the Preservation of Latex. 1924
No. 33. Investigations on Samples of Plantation Para Rubber from Ceylon. 1924
No. 34. Investigations on Samples of Plantation Para Rubber from Ceylon. 1924
No. 35. Investigations on Samples of Plantation Para Rubber from Ceylon. 1924
No. 36. Investigations on Samples of Plantation Para Rubber from Ceylon. 1924
No. 37. Investigations on Samples of Plantation Para Rubber from Ceylon. 1924
No. 38. Investigations on Samples of Plantation Para Rubber from Ceylon. 1925
No. 39. Do. (Final Report Series I) 1925
No. 40. Do. Series II 1926
No. 41. Do. First Interim Report on Artificial Ageing Tests. 1926
No. 42. On the Smoking of Sheet Rubber in Relation to Mould Prevention. 1926
No. 43. The Inter-Relationship of Yield and the Various Vegetative Characters in *Hevea Braziliensis* (out of print). 1926
No. 44. The Construction of Smokehouses for Small Rubber Estates (out of date). 1926
No. 45. The Efficiency of Disinfectants and Fungicides. 1927
No. 46. The Control of Bark Rot by Disinfectants. 1927
No. 47. Report on Variability of Ceylon Estate Grades. 1927
No. 48. Brown Bast and its Treatment. 1928
No. 49. Report on Causes of Variation in Plasticity. 1928
No. 50. Crepe Rolling. 1929
No. 51. The Curing of Sheet Rubber. 1930
No. 52. The Preparation of Uniform Rubber. 1932
No. 53. Oidium Leaf Disease. 1936
No. 54. Report on a Visit to Malaya, Java and Sumatra. 1937

Booklets at Rs. 2.50 per copy.

Guide to the Preparation of Plantation Rubber, by T. E. H. O'Brien, N.Sc., A.I.C., Chemist.

The Budding of Rubber, by R. A. Taylor, B.Sc., Physiological Botanist (out of date)
Diseases of Rubber in Ceylon by R. K. S. Murray, A.R.C.Sc., Mycologist.

Copies of the following publications of the Rubber Research Institute of Malaya are available at the prices indicated :—

Planting Manual No. 4—Latex Preservation and Shipment, Rs. 3.50
Planting Manual No. 5—The History and Description of Clones of *Hevea Braziliensis*, Rs. 5.00.